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Saving the Motorist From Himself

Conditions Which Have Led to Fourteen Percent of the Motor Car Deaths

By H. W. Slauson, M.E.

WARNING signs will not do it; gates will not do it; horribly fatal examples do not do it. What will?

If we knew how to save the motorist from the results of his own carelessness and haste, we could eliminate the annual number of automobile deaths in this country by at least fourteen percent; and while the number of grade crossings is being reduced by the construction of bridges, or underpasses, the proportion of motor car fatalities at railroad crossings is some one percent higher than was the case the previous year.

"Look Out for the Locomotive"

We cannot blame the engineer, the directors or stockholders of a railroad company when a passenger train, running at some thirty to sixty miles an hour, strikes a motor car which has been stalled on the crossing, or which has been raced across in the vain endeavor to get ahead of the engine. To be effective and efficient, and in fact, to serve any useful purpose whatsoever, the passenger train must be run at as high a speed as is consistent with the comfort and safety of those whom it carries.

A high-speed railroad train, even though equipped with powerful air brakes on every set of wheels, may require a thousand or more feet in which to be brought to a stop. Therefore, if safety demands that either the railroad train or the automobile must be slowed down or brought to a stop before approaching a grade crossing, expediency, efficiency and every known practical law of fairness and equity demand that it should be the motor vehicle which should "Look Out for the Locomotive" and not the locomotive which should look out for the motor car.

But modern conditions of transportation and communication demand that there shall be tens of thousands of highways crossing railroads at the same level, for the billions of dollars required to separate the levels of road and track at such crossings, would create such a burden upon railroad, car owners and, in fact, all tax payers, that even the great wealth of this country is insufficient to accomplish such a task within the present generation.

But the inability of a railroad train to stop in time to prevent accidents entails a legal and moral obligation upon the railroad company to furnish certain warnings, which can be heard or seen by those about to cross the track. Antiquated warnings such as engine bell and whistle, and "Stop, Look and Listen" signs placed directly at the side of the track are still in use, and have been supplemented by certain more or less ineffective devices such as flimsy, hand-operated crossing gates, automatic electric bells and gongs, and flashing lights or waving semaphores.

I referred to some of these warning signals as antiquated, not so much because of their nature, as the lack of effectiveness due to their location. Every one, practically, is placed *on* the railroad property which, at most, extends only a few feet either side of the rails. To place a warning sign or a barrier at the very point of danger was all very well in the horse-drawn days when highway speeds of travel averaged five miles an hour. In those days, a vehicle could be stopped within fifteen or twenty feet, and a gate or warning sign placed directly at the crossing and which could be seen fifty feet away, provided ample space in which to avert all danger.

Legislate Against Imitation Warning Signs

We have referred in a preceding article of this series to the number of railroad crossing gates which have been literally smashed to kindling wood by the recklessly-driven automobiles which have tried to beat the railroad train to the crossing. This is the popular conception of the "gate crasher" but second thought will make us realize that not even the most foolhardy driver will wilfully and intentionally risk at least his radiator and windshield in an argument with a forty-foot stick of wood. As a rule, such a driver has been going too fast to be able to stop in time to prevent collision with the gate, or he has not received sufficient warning of the existence of a grade crossing which might lie just beyond the blind turn or the steep embankment.

And speaking of warnings, let me again empha-

Bureau of Standards

THE TEST CAR

Note the two red-lead-loaded revolvers attached to the running board. One is discharged by the investigator and the other by the application of the foot brake

Bureau of Standards

MEASURING THE DISTANCE

The distance traveled by the car between the firing of the warning signal and the application of the foot brake is indicated by splashes of red lead discharged by the revolvers

Brown Brothers

A FRIENDLY WARNING

The motorist is warned against driving down a steep incline and is directed to a safer route

size the danger and absolute menace of the small advertising signs which line our country roadways in complete or partial imitation of touring direction, cautionary signals and other information either valuable or vital to the motorist. If you have passed a dozen signs in the last half-mile telling you to stop at Smith's for ham and eggs, or at Brown's for gasoline and oil, you will pay but scant attention to another one of similar size which may be intended to warn you that there is a dangerous railroad crossing five hundred feet around the next turn.

Recommendations made by Secretary Hoover's Highway Safety Conference to the effect that roadside signs be restricted to vital and valuable warnings and touring directions, may, if followed by all of the state motor vehicle commissions, result in a very material saving of life at railroad crossings.

But physiologists tell us that the reaction of the human mind to a visual warning is not as prompt as is that produced by sound, especially if such sound be in the form of a sharp report. We have showed in a previous article that a very definite distance is required in which to bring a moving vehicle to a dead stop, and that there must be added to this time a certain interval required for the mind of the average driver to translate a visual or audible warning signal into the necessity for an application of the brakes. A warning must first attract attention, and then impress upon the driver the necessity for reduced speed, or a complete stop.

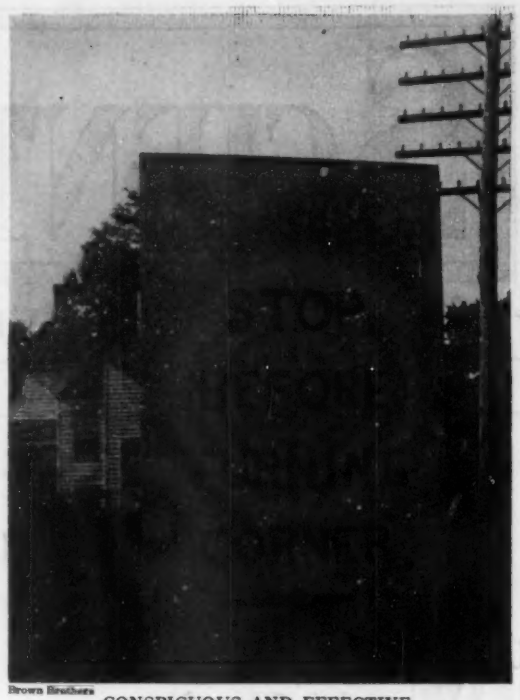
All of this takes time, and it is, therefore, absurd for a driver to say that he can stop "instantly" as soon as he hears or sees a warning signal. Tests recently made by the United States Bureau of Standards have demonstrated in a scientific manner that even under the very best of conditions of preparedness, over one-half a second will elapse between the time that the driver has received the warning to stop, and the beginning of the application of the brake. In other words, these tests have showed that, when traveling at thirty miles an hour, the driver who is expecting any instant to be compelled to stop, will allow his car to travel twenty-two feet before he begins to slow it down.

Women Equal Men

The tests in question were made on a variety of human subjects and included the most experienced taxi drivers, college students and other normal operators of automobiles. Two revolvers were fastened to the right-hand running board of the test car, and so connected that the trigger of one could be pulled by the investigator who sat alongside the driver, and the trigger of the other operated as soon as the foot brake was pressed.

These revolvers were filled with red lead, which would make a very definite and easily measured mark on any pavement. Each driver to be tested was told to hold the speed of the car at exactly thirty miles an hour, and to apply the brake as soon as he heard the first report of the tester's revolver. Of course, the distance between the two red lead marks made by the revolvers would indicate, accurately, the amount of car travel between the stopping signal and the actual application of the brakes. This average distance of twenty-two feet, translated into time, amounted to .54 seconds.

Now, remember that the human mind reacts more quickly to an audible signal, and that in every case the driver was expecting such signal at any instant, and therefore was mentally and physically prepared to shift his foot from the accelerator to the brake. Also remember that this was an average figure obtained from testing an exceptionally good class of drivers, although some of these required as much as a second and a half to permit wit and muscle to function. It is a gratifying tribute to feminine perception to note that the women drivers on whom such tests were made indicated an average practically the same as exhibited by the men tested under the same conditions and with similar driving experience.



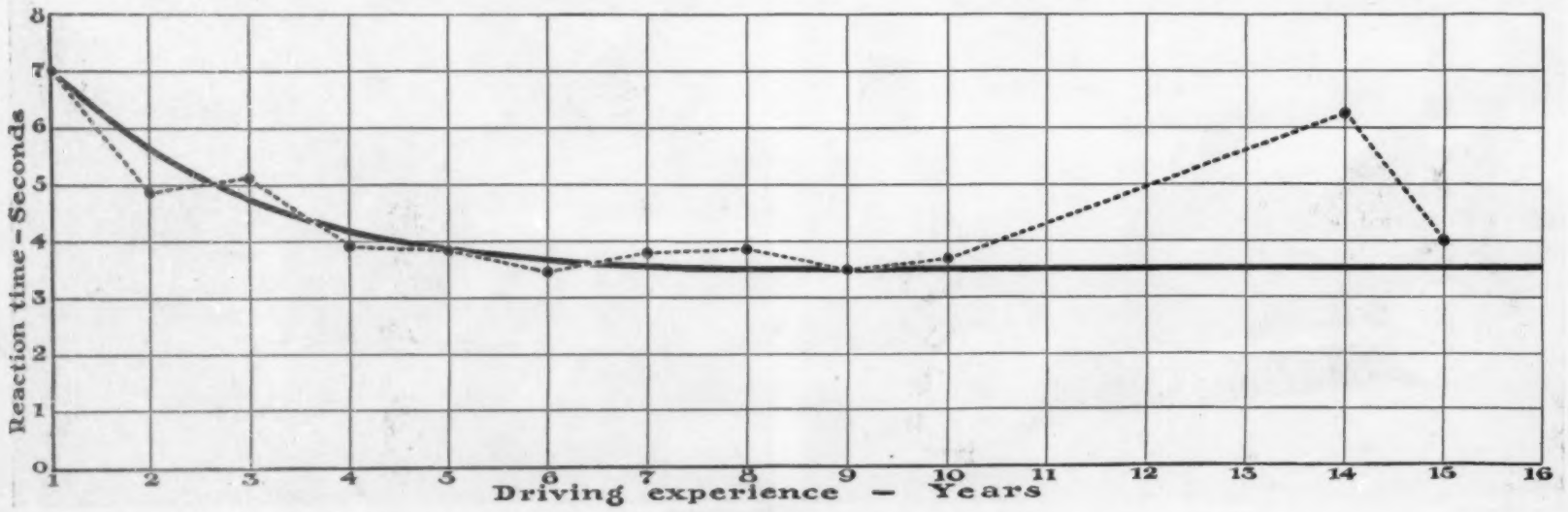
Brown Brothers

CONSPICUOUS AND EFFECTIVE

A machine brought to a full stop before turning a dangerous corner necessarily must go slowly in making the turn

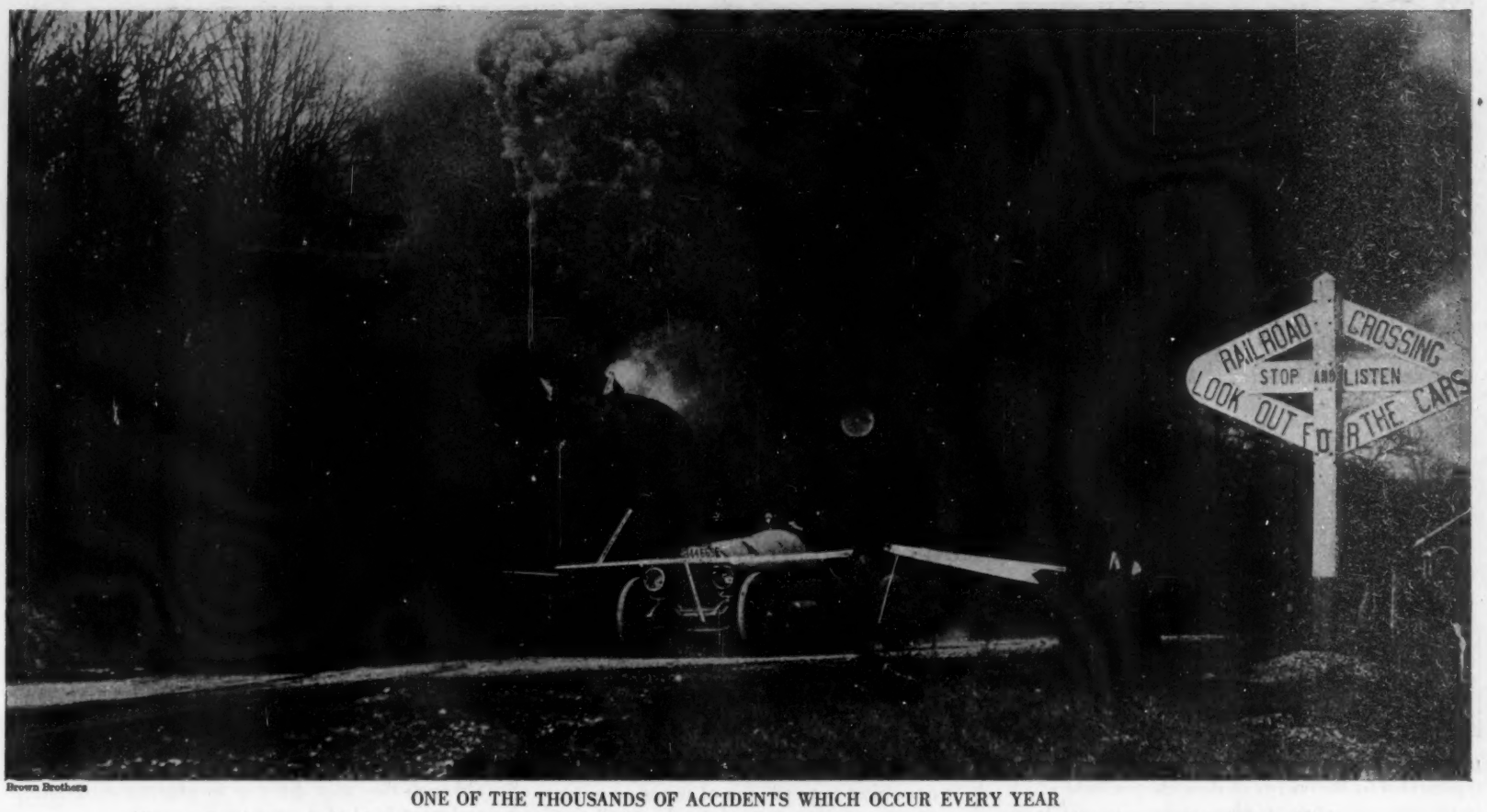
Such figures indicating the mental and physical lag existing in every normal driver, added to the fifty to seventy-five feet required for good brakes to act before a car traveling thirty miles an hour can be brought to a full stop, may serve to explain, in a measure, the basic reason for gate crashing and other forms of railroad crossing accidents and fatalities. We cannot get away from the fact that speed at the crossing, or rather when approaching the crossing, is the contributing factor. This has been recognized by the highway safety conference, and is the reason for the recommendation that the highway commissioners, public service commission or other similar body be empowered in each state with the authority to designate certain highway and railway grade crossings at which every vehicle will be compelled to come to a full stop before reaching the rails.

Maximum safety might require that *every* railroad grade crossing should be so designated; but it is obvious that this is impractical. Many country highways cross railroads on which but two or three trains a day operate in either direction. On other highways, there is such a veritable stream of traffic



A GRAPH WHICH SHOWS THE MOTORIST'S REACTIONS

The smooth curve indicates the average relation between driving reaction and years of experience. Note that "average perfection" is reached at the end of eight years, with no improvement thereafter



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ONE OF THE THOUSANDS OF ACCIDENTS WHICH OCCUR EVERY YEAR

Flimsy railroad gates, ineffectively placed warning signs, dangerous grade crossings and last, but not least, careless driving often result in fatal accidents

that for each car to stop would create such congestion as to cause cars to pile up for hundreds of feet.

We know what happens during heavy traffic on a trunk line highway, if one car slows down or pulls off to the side of the road to discharge or take on a passenger. Imagine, then, the condition if every car was compelled to come to a complete stop as soon as it reached a given specified point. We might as well go back to the days of the ox-cart, so far as the speed of travel from present day methods is concerned.

Basically, as already pointed out, one of the primary troubles lies in the nearness of the barrier or warning sign to the actual point of danger. We must obtain the cooperation of railroad companies and county and township highway authorities to place semaphores, signs, lights, gongs and even gates more scientifically in keeping with the traveling speed and stopping distances of modern traffic.

The fear of punishment or physical discomfort might serve more to deter the average driver from approaching a railroad crossing at too great a speed, than would the danger of loss of life, in case of collision with the on-coming train; for you will always find the motorist who is willing to take a chance in the belief that his usual luck will hold, but who will not face the certainty of car damage or other money and time consuming accident. For example, if an automatic device could be installed which would sprinkle broken bottles on the highway a half minute or so before the approach of a train, and which would remove this glass after the train had passed, and if this could be operated in conjunction with a plainly-read signal which would indicate when the road was glass strewn and when it was clear, we would find that every motorist would place tire value ahead of any desire to beat the train to the crossing. We might even place a series of "Thank You Ma'ams" or other bumps on every right-hand roadway two or three hundred feet from a railway crossing, and the physical discomfort attendant upon driving over these at high speed would cause the average motorist to slow down; and he would do so automatically after he had learned to associate such road conditions with every warning sign indicating a railroad crossing.

Brown Brothers

A DEATH TRAP

The motorist driving up this hill has little vision of the railroad crossing at the top

Stalled Motors Cause Accidents

An ingenious automatic device has been suggested which consists of magnets embedded in the right-hand side of the road, and which, through the excitation of an especially installed electrical system connected with the ignition of every automobile, would cause the spark to be cut off whenever such automobile passes these concealed magnets at a speed greater than twelve or fifteen miles an hour. But one of the greatest causes of railroad crossing accidents is the motor which becomes stalled on the tracks directly in the path of the oncoming train. The operation of the device in question requires that the motor bonnet shall be raised to reset the ignition before the car can again be started, and there is the possibility that a car, the engine of which has been automatically stopped in this manner, would coast just far enough to reach the railroad crossing before the driver would realize what had happened.

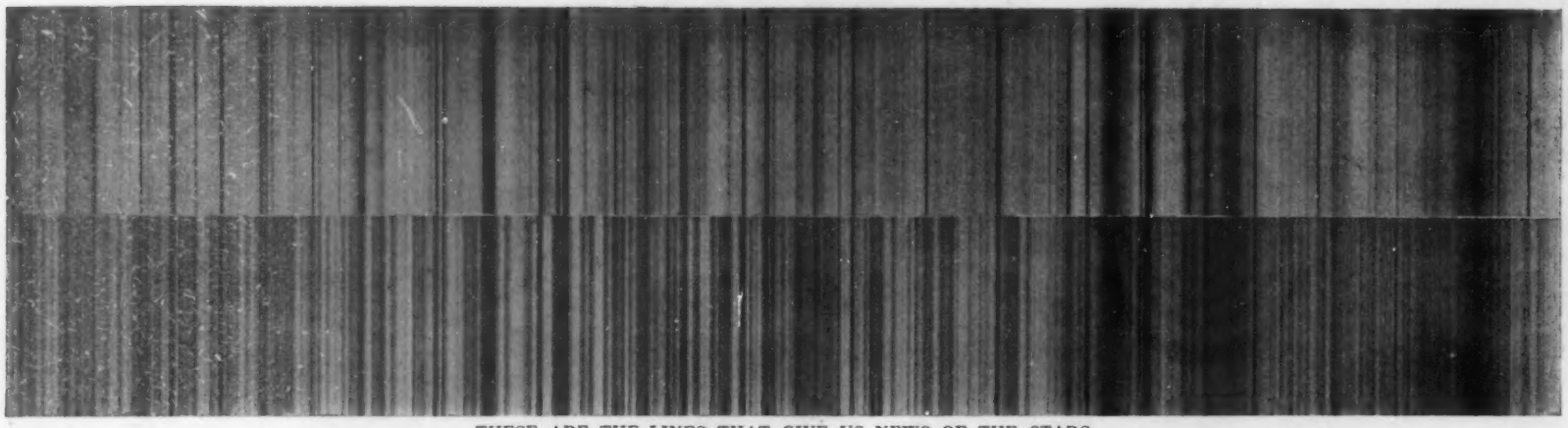
Of course, placing gates and other manually controlled devices two or three hundred feet on either side of every approach to a railroad crossing would entail the use of two operators, instead of one. By far, the large majority of railroad grade crossings do not warrant the employment even of one man to prevent conflict between railroad train and highway vehicle, and therefore, an automatic device is needed which will warn the motorist in ample time for him to apply his brakes and come to a complete stop.

The problem is a tremendous one, and a fortune awaits the individual or company who can solve it.

Brown Brothers

AN OUNCE OF PREVENTION

This sign gives the motorist sufficient warning to enable him to slow up or even stop his car



THESE ARE THE LINES THAT GIVE US NEWS OF THE STARS

The dark lines on these two spectra, placed together for comparison, indicate the atoms that exist in vapors through which the light has passed

Matter, Ether and Energy

Can Atoms and Electrons Be Destroyed and Is Matter a Form of Ether?

By Sir Oliver Lodge, F.R.S.

ELECTRONS and protons are the building stones of which matter is made. The atom of matter is composed of them, and all matter is composed of atoms. Electrons are evidently composed of ether, because whatever mass they have is represented by the energy of their electric field which is certainly an etherial phenomenon. Apart from this field they seem to have no other existence; they are electric charges and nothing else.

We cannot make a similar statement about a proton, because we do not know enough. For that we must wait. The things that I might attempt to say about protons are too speculative at present, and would probably be wrong.

Meanwhile we know that an electron has mass represented by its energy. We also know that a moving electron is more massive than one at rest, and that as its speed increases its mass and energy slowly increase also, preserving the same proportion to each other. Matter is turning out to be one of the forms which etherial energy can take—a very curious and permanent form, not easily changed into other forms.

At least not the whole of it is easily changed. The part of it which can be easily changed is the extra mass acquired by a moving electron. This extra mass behaves like additional matter, but not like permanent matter. When a moving electron is stopped, this additional matter disappears. It does not vanish into nothingness; it is changed into radiation. It is as though the extra mass were shaken off or shocked off from the electron. It travels out into space as a quantum of radiation, with the speed of light. It may actually be visible light, but it must be radiation of some kind, whether it affects the eye or not. In its best known and simplest form it is an X ray.

All Radiation Comes from Electrons

All radiation is produced by changing the motion of an electron. The kind of radiation depends on how fast the electron is moving and how quickly it is stopped. The electrons circulating round an atom have the power, the peculiar power, of dropping from one orbit to another, every now and then. Their orbits are not fixed like the orbits of the planets. It is as if Mars could suddenly drop to the orbit of the earth and begin circulating there. That is one of the peculiarities of atomic astronomy, one in which it differs from celestial astronomy.

Where Does the Sunlight Go?

The sun continually pours out vast quantities of energy into space. Other stars do the same. Some of the hotter ones give out millions of times as much energy as does our relatively small and feeble sun.

What becomes of all this energy? Where do the light rays go? Does space absorb them or do they go on forever?

It is possible, of course, that they do go on forever, continually farther and farther out into the infinity of time. But Sir Oliver Lodge thinks that they may do something far more important. Perhaps they generate matter. Perhaps they turn into electrons and atoms, which may combine sometime to form new suns.

Matter makes energy in the sun and in the stars. It may be that energy makes matter out somewhere in the depths of space.

Atomic astronomy is in some respects simpler than celestial astronomy. All the planets or satellites revolving round the atomic nucleus are similar to each other, identical in everything except speed and position. Their orbits, although very complicated, are by no means distributed at random. Only some orbits are possible. The satellite or planetary electrons can occupy certain positions and no others. They can drop from one of these possible positions to another and when they do so they emit energy in the form of radiation.

It is as though they were stopped at the new orbit and thrown into shivers by the stoppage, so as to emit X rays or light or some other kind of radiation. The kind of radiation they emit depends on how far they have dropped and where they drop to. If they drop from a long way off (say a millimeter) to a position close to the nucleus, they get up a big speed, shiver quickly. They then emit ultra-violet radiation or X rays. If they drop only a little way, and still remain at some distance (say the millionth of a millimeter) from the nucleus, they emit infra-red radiation, the waves of which are shorter than those of visible light.

Each drop nearer to the nucleus corresponds to a line in the spectrum. By analyzing the spectrum the structure of the atom has been made out. We have more to learn about this process of drop and why certain orbits only are possible, but all observers agree that radiation is due to a sudden drop, although they may differ as to what the drop means and what kind of thing it is.

This process is a reversible one. Not only is radiation emitted; it can also be absorbed. When radiation is absorbed the electron is jerked up again. How far it is jerked up depends on the kind of radiation. A "hard" X ray, consisting of very short wavelength waves, will jerk it up a long way, even out of the atom altogether. An X ray of longer waves or a ray of visible light will jerk it up from an inner atomic orbit to an outer one. From thence, in due time, it may drop back again, giving out exactly the same energy as it received when it made its upward jump. All these details can be followed, and are studied, by the great spectroscopic analysts who are now at work.

Matter and Energy Are Equivalent

What concerns us now is the fact that matter and energy are equivalent to each other. I do not say identical; they are different forms of energy. The important thing is that they *are* forms of energy, so that when one disappears the other makes its appearance. Energy is always protean in form. At one moment it can be mechanical strain, as in a stretched bow; at another moment it is visible motion, as in an arrow. At one moment it is in the form of compressed air or steam; at the next it is the revolution of a fly-wheel. At one moment it is a raised 20-ton weight; at another moment it is the heat and noise when the weight has fallen and crashed. At one moment it is the energy of an electric current, that is of magnetism; at the next it is the motion of a street car, propelled by that magnetism. At one moment it is an electric charge; at another it is the heat and light of a spark.

So also, we are now surprisingly able to say that at one moment a portion of energy is matter, mass, inertia, momentum; and that at the next moment it is away traveling in the ether as radiation. We are also able to say that energy which is now radiation can make an electron jump, and thus constitute an electric current, with all its intangible and protean properties.

Are we able to say that radiation can actually

generate matter, not only the temporary form of matter associated with electromagnetism, but the permanent form of electrons and protons? Here we must hesitate and proceed warily. We do not know that at present. There are some who think it probable, but all are willing to hesitate and seek the aid of further experiment. The birth of permanent matter would be a great discovery.

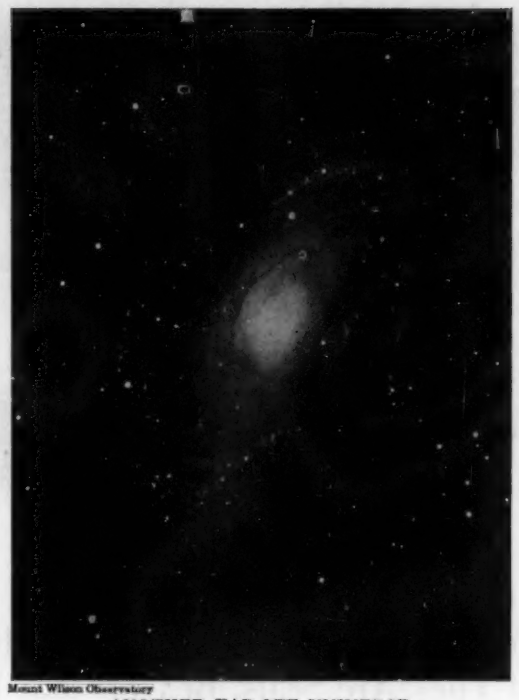
But we can proceed, with some hope of getting an answer, to the converse question, Do an electron and proton ever clash together and obliterate each other in a pulse of radiation? Can matter, as we know it, radiate itself away and cease to be matter, until at some future time perhaps it can be reconstituted?

We cannot answer these questions yet. There are some who think that although the process does not go on as yet in our laboratories, under the conditions of temperature and pressure there available, yet in the extravagant conditions of pressure and temperature which exist in the stars, the process may be occurring. The radiation of the larger "giant" stars is tremendous and it goes on for millions of ages without apparent diminution. The sun is rather a small star, but it is known to have been radiating for millions of years, perhaps for thousands of millions. How can we account for all that radiation?

Astronomers believe they can answer this question first. They suspect that the very constituents of the atoms in the stars must be falling together. Permanent matter must be disappearing. I do not say that it is true. No one positively asserts, as yet, that it is true. But if it were true, it would account for the energy. Matter may not be so permanent as we used to think. It seems permanent enough under terrestrial conditions, but we can see how the destruction or transformation of matter could produce radiation. We are beginning to think that that is how some of the radiation is produced.

Rivers and Rain Come from the Sun

We can already say pretty definitely that wherever radiation is produced matter disappears. Whether it be only the temporary form of matter represented by the greater mass of a moving electron, or what has hitherto been thought of as the permanent form of matter, is the only question. The amount of



Mount Wilson Observatory

ANOTHER FAR-OFF UNIVERSE

This spiral nebula, in the Constellation of the Great Bear, may be a great cloud of stars, comparable to the universe of which we are a part. Is its matter being wasted away or is it being reformed?

radiation leaving the sun is known. A fair proportion of it is received by the earth. That is what is responsible for all the activities on the earth; the winds, the rain, the rivers, the vegetation, and life generally. But the radiation which the earth receives is but a minute fraction of the whole. Expressed as matter, it is about three hundred pounds a minute.

The sun as a whole is losing four million tons of matter every second! Accepting what we have said about the connection between matter and radiation this amount is a mere question of arithmetic. Can the sun stand such a loss without perceptible diminution? Yes, it makes no perceptible difference. The amount of matter even in the earth is 6,000 million-million-million tons. The sun has three hundred thousand times more than that. There is no difficulty in supposing that it has been losing mass at much the same rate as now for ten thousand million years. Less than one-tenth of one percent of its substance would have been radiated away in that time.

The antiquity of the solar system is fearful. Life on the earth, in some form or another, has been going on nearly all that time. But not for all that time has there been intelligent life as we know it now. The ages of the earth's past seem to have been a sort of preparation for the life and mind which now is and for the mind which is still to come. It has been a slow and laborious process. Has the outcome so far been worth all the labor and time spent in preparation? Faith is needed to suppose that. Mankind, with its trivialities, seems hardly worthy. Yet by faith we feel bound to suppose that there is some far-seeing Design, some lofty meaning in it all, and that the ultimate outcome will be worth while.

The Grandeur of Man's Mind

Meanwhile here we are, conscious creatures endowed with the faculty of understanding; with the power of work and of mutual help. We have become agents in the universe endowed with consciousness. We are beginning to understand something of the processes at work. We are beginning even to have some power, not only of understanding but of helping, of doing things which would not otherwise have been done. And so, even while still on the range of the material universe, we may hope that mankind will become worthy of the magnificent scene in which its lot is cast. And we ourselves, though we are but a stage in the majestic pageant, can yet understand that here on earth is scope for free response to a Divine Will, and can wonder at the Patient Effort.

Depend upon it, nothing is haphazard, things are not left to chance. Everything is amenable to law and order. Everything points to a rational Plan, of which we know neither the beginning nor the end, but towards which we can help. In face of all that, shall we allow ourselves to squabble about trivialities! Or shall we realize that we are the heir of all the ages, that the destiny of mankind is being partly entrusted to us, and that humanity has a future, a potential future beyond our wildest dreams!

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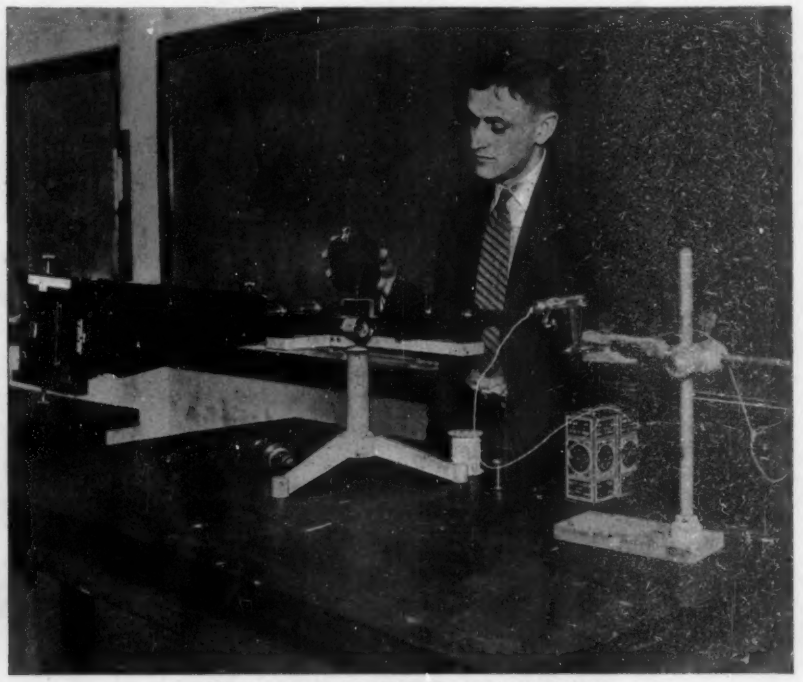
SIR OLIVER LODGE FACES THE MICROPHONE

The views expressed in this remarkable article were first suggested by Sir Oliver in a series of scientific talks over broadcasting station 2LO, in London. Lady Lodge is seated opposite Sir Oliver, with the microphone between them



HOW ETHER RADIATION IS STUDIED

The remarkable instrument called the spectroscope serves to analyze the rays of light, whether they come from matter here on earth or from the most distant stars. Light from the electric tube at the right is analyzed in the photographic camera at the left

The Skin Game

In the Great Fur Masquerade, Muskrats, Rabbits and Weasels Pretend They Are Seals, Beavers and Ermines

By Milton Wright

"THE Colonel's lady and Judy O'Grady are sisters under the skin," is one of the well remembered lines of the bard of barracks. It might well have been uttered as he stood on the curb on Main Street and watched the stream of fur-clad girls pass by. Which was which he could not have told you.

Try it yourself some time. The girls are buying furs now and soon they will be wearing them. A charming miss comes tripping along all togged out in her Sunday finery. Is she Judy who stands behind the ribbon counter in the Big Store, or is she the daughter of the richest man in town, a charge customer in the same store? She snuggles in a handsome coat of ermine skin. That garment must have cost $1,000 at the very least, you think. But it didn't. That skin is white coney. Those creases by which you have learned to distinguish ermine have been put in with a hot iron. The garment cost exactly $54.50. It looks "just as good" as the genuine article and possibly will wear a lot better.

Few products lend themselves so readily to imitation as do furs. Few are so susceptible to misrepresentation. Within the next two months thousands of women are going to buy muskrat, rabbit or weasel skins in the belief that they are getting bargains in sable, beaver or ermine. So cunning is the imitation that the average man or woman will never suspect that the garment is an imitation.

Microscope Infallible Test

The one infallible test lies with the microscope. Each individual hair in the fur is of a shape and structure that reveals unmistakably what the animal is. The hair of one will appear long and straight; another will be seen as a series of cones strung one on top of another.

One of the finest and most prized of all furs is the sable. It belongs to the marten family and only the expert eye can tell it from its less expensive cousins. The animal is about a foot and a half long with a tail not more than nine inches. Its fur is soft and brilliant. The more uniform the color, the greater is the value of the skin. The country and climate in which the animal lives determine the color of the fur, the length of the hair, its thickness and the quality of the skin in general.

Little wonder that an effort is made to imitate this magnificent fur. The wonder is that cheaper furs are palmed off as true sable so successfully. Even the furrier must be keen to detect imitations, especially when the imitating martens are cleverly dyed.

The sable's chief imitators are the Canadian marten and the weasel. Under the microscope the structure of the hair of each is seen to be radically different.

Fads in furs come and go. Usually they are the result of an especially good catch, or the successful cornering of the market by a shrewd dealer. With a large supply of a particular fur on their hands the dealers are faced with two alternatives: to let the price drop or to increase the demand. With the art of propaganda in its present high state of perfection it is easy to see which course is adopted. So adept have furriers become in popularizing particular furs that they succeed in having an increased supply accompanied by an increase in price.

THE MUCH MALIGNED SKUNK
One of the most valuable American fur bearers

Pony coats illustrate the temporary demand for a particular kind of skin. A few years ago they were all the rage. Now one rarely sees one. The reason is that immense quantities of Russian ponies were in the hands of the dealers immediately following the World War and they were purposely made fashionable in order to dispose of them.

Recently monkey fur has become popular. This fad, too, will die out in a short time. Monkey fur is not particularly expensive because so little of it is used in any one garment. It is used almost exclusively for trimming. For this reason there is not much temptation to imitate it, although in some cases Chinese human hair is used to simulate monkey.

Naturally, the size of the season's catch has an effect on the furs used to imitate other furs. Skunks and racoons, for example, ordinarily bring about the same price. When skunks are scarce and racoons are plentiful the racoons are dyed to imitate the skunks, and when skunks are plentiful and racoons are scarce, skunks are dyed to imitate racoons.

Most Skunk Is Really Rabbit

One of our most popular animals is the skunk. Yes, popular is the word, for out of the forty-eight states in which the skunk occurs, thirty-five give him protection. In most cases this protection was given at the urgent demand of the farmers who appreciate his importance as a destroyer of insects and small rodents.

Europe appreciates skunk fur more than does America and immense numbers of pelts are sent abroad every year. The difference between skunk and sable is fairly easy to detect, the skunk hairs being much smoother. This is seen readily under the microscope where the skunk hair appears as a straight tube with a granulated center. In color the fur is a brownish black under the belly of the animal with lighter shades on the sides and back.

So valuable is the skunk that it is imitated quite generally; and most "skunk" fur you see is in reality rabbit or hare. The hairs of both these imitators have distinctive micro-structures, so that it is not difficult to distinguish them from the more expensive and durable skunk. They are longer than skunk hairs and soft and silky.

A useful little impostor is the weasel. Its fur is brownish red underneath and white on top. The

fur is of little value, and to make it look like sable it is dyed a dark brown. The microscopic structure of the hairs of the two animals is similar, a fact which makes identification difficult. The weasel also is the chief imitator of kolinsky, a popular fur obtained from the Siberian mink.

One of the most prized of all furs is ermine. In reality the ermine belongs to the weasel family and very strongly resembles the ordinary weasel. Their habits are similar. The ermine is about eight inches long from the tip of its nose to the tip of its tail, with the tail itself about three inches long. The end of the tail is a beautiful black in all seasons of the year. In winter the ermine turns white, while common weasels remain at all times a uniform reddish brown. The beautiful contrast between the snowy white coat of the ermine in winter with the jet black tip of its tail is what makes the fur so valuable.

White rabbit is often used to imitate the ermine but the substitute is not difficult to distinguish under the microscope. Conies are also extensively used as imitators. The imitators most difficult to locate, however, are the weasel and the marten, for the micro-structures of their hairs are very similar to the hair of the ermine.

In recent years summer ermine has become popular, and this reddish brown fur is easily imitated by using the skin of the weasel. Weasels are found in many countries, including our own, but the Chinese and Japanese weasels, being the cheapest, are the most generally used. Because their coats are of a champagne color they are easy to dye.

Blue Fox Almost Unobtainable

Among the rarest and most expensive furs are some of the foxes. The fur of the ordinary or common red fox is not particularly desirable in itself, but it is used extensively to simulate the finer and more costly pelts of its relatives.

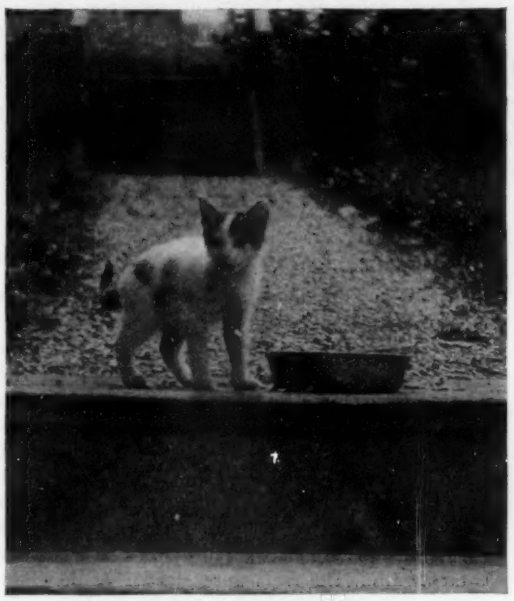
The skin of the blue fox is almost unobtainable and is especially valuable. This valuable animal's hair is thick and the color varies from an ice blue to a lead blue; the bluer the fur the more costly it is.

To dye the skin of a common red or gray fox so that it looks like a blue fox is easy. Unfortunately, when the gray fox is used the microscope shows no difference in the hair structure. There is, however, a difference in the quality of the hair, that of the blue fox being harsher and more brittle than that of the ordinary fox; but the main distinguishing point is in the tail, which is much shorter in the case of the blue fox.

The silver fox and black fox possess beautiful furs, and because of the scarcity of the animals, the skins are costly and there is ample temptation to imitate them. It is not generally known that the fur of the black fox is more valuable than that of the blue fox. The silver and the black fox inhabit cold countries like Siberia and Canada. Under the microscope it is not difficult to distinguish their furs from the dyed common fox.

Fox is generally a spring and summer fur and is used for neck pieces rather than for coats. Red fox in its natural state has been popular this year, a fact which has subjected it to imitation. Wolf and dog pelts have been used for this purpose, after treatment in suitable ways. There is no resemblance between these substitutes and the hair of the fox.

Another high-priced fur subject to imitation on a large scale is the chinchilla. This animal is a kind of rabbit and possesses a long bushy tail. The fur is of fine texture and does not wear well, but its beauty and softness make it attractive and desirable. It is imitated extensively by the use of the skins of the rabbit and the hare.



LITTLE BUT USEFUL

Our domestic pet not only catches mice, but her fur is sometimes used in the manufacture of fur coats

In general the darker shades in furs are more expensive than the lighter. Take the squirrels, for example. They are found almost everywhere in the temperate zones, but the Russian squirrel is the most desirable of all because of the dark cast in his coat. The texture of squirrel fur is more receptive to dyes than most others. For that reason squirrel is generally the fur used when style originators seek to popularize new shades.

It is a common practice to use the skins of the common squirrel to imitate the gray squirrel. The gray squirrel itself is used to imitate the fur of the sable and the marten.

At the present time the number of squirrel skins used in different parts of the world is enormous. They are either worked up whole, or the backs are cut out to make coats, muffs and neckpieces, while the bellies are used for linings. Many of the skins are dyed and blended into all kinds of colors, particularly sable, and in imitation of chinchilla.

Lambs are used extensively for fur garments. One that is especially prized is the astrakhan. This is the fur of a Siberian lamb that is born dead. The finest comes from the province of Astrakhan. The fur is glossy, short-napped and of a lustrous or moire black. When this fur is not obtained from still-born lambs it is derived from animals that are given special attention in the way of food and water.

In South America new-born lambs are left on the prairie in mating season and die of exposure. Others are taken prematurely from the mother. These are known as broadtails and the operation involved in producing them is what makes them expensive. Broadtail fur is flat with just a suggestion of a curl. It is highly prized. Ordinary lamb fur, of course, is treated to imitate it.

The beaver is also an important fur. It is highly prized and wears well. It is often imitated by the less expensive rabbit, hare and muskrat.

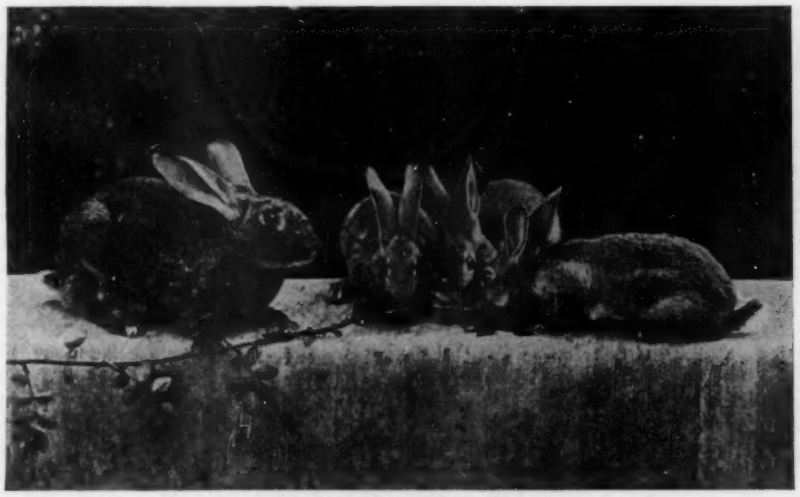
No Deception About Hudson Seal

The muskrat is one of our most important fur-bearing animals. It is found in the greater part of the American continent. He is about twenty-one inches long, including tail, or about four times as large as the common house rat. His fur is soft and thick, a rich brown in color, varying in shade with the season and the locality.

With approximately six million muskrats being dyed in a single year to look like seals, it is little wonder that the muskrat supply is diminishing, and everywhere the laws restrict trappers more than formerly to prevent the taking of unprime skins.

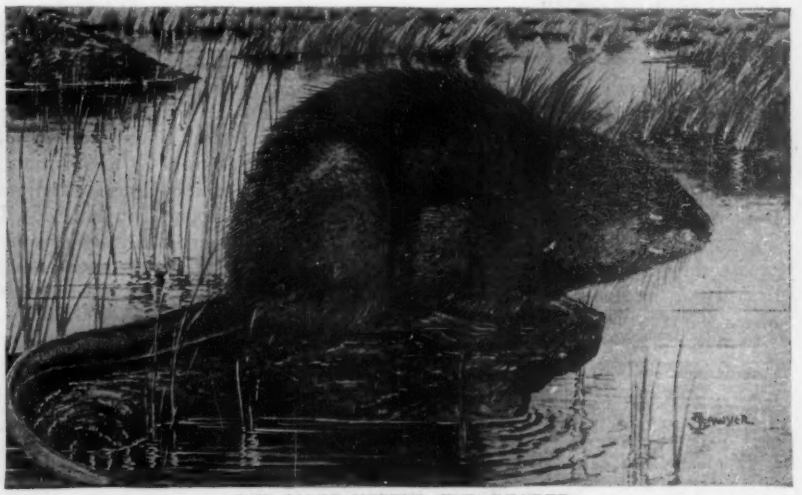
So satisfactory is the substitution of muskrat for Alaska seal that there has ceased to be any deception about it. Everybody knows that there is no such animal as the seal found in the vicinity of Hudson Bay and that the Hudson seal is an animal unknown to natural history. Every woman knows that Hudson seal which both looks well and wears well is simply dyed muskrat. Muskrat, itself, is often imitated by rabbit and hare, but the imitation is easy to detect under the microscope.

And so we might go on indefinitely. Things are not what they seem to be when it comes to fur coats and neckpieces. Only the expert can tell which is the real thing. All furs have a market value, and a fur cheap in price is apt to be cheap in quality.



A GROUP OF BELGIAN HARES

The skin of this animal is used in the imitation of ermine, skunk and beaver fur



OUR MOST USEFUL FUR BEARER

Six million of them are made into coats annually—but none of them is called muskrat

Our Point of View

Abolish the Shipping Board

IT begins to be evident that both the Administration and the country at large are prepared to make a very drastic reorganization in the management of the great fleet of ships which was built to meet the emergencies of the late war. Obviously, the first step to be taken is to abolish the Shipping Board, which has made a woful failure of the administration of the costly properties under its care. The major item in these was a fleet of about 2,200 ships. Today that fleet has shrunk to about 1,200 ships. Of these, 887 are laid up and 320 are in operation. If we estimate the present total assets of the Shipping Board at, say, 300 million dollars, the net loss stands at about three billion dollars. This money has gone and may just as well be written off as a war loss. Under the Shipping Board's management there has been a total deficit of from 50 million dollars down to last year's deficit of 24 million dollars.

The country is unalterably opposed to a subsidy, and it is beginning to realize that making up the yearly deficit out of the Treasury is simply a subsidy under another name. Hence it is that the Administration and the country believe that the time has come for the Government to quit the shipping business. It begins to look as though the only people who have a real interest in maintaining the Shipping Board are the job holders; and now that the personnel has been cut, even this aspect of the question is beginning to lose its appeal to the politicians. If any part of the existing administration is to be retained, it should be the Emergency Fleet Corporation which, under Rear Admiral Palmer, one of the ablest of our naval officers, has been doing some really constructive work. We are inclined to believe that the best policy would be to transfer Admiral Palmer and his organization to some one of the government departments, and sell such ships as are serviceable to private owners, to be operated under the American flag. The rest of the ships should be sold as junk at the highest price they will bring, whether from Mr. Ford or any other man or combination of men who will put in a bid for them. It might be a good plan to allow the Emergency Fleet Corporation sufficient funds to maintain serviceable ships on certain mail and trade routes which it is desirable to keep open, but upon which any private organization will find it at present impossible to earn any income.

Oil Pollution of the High Seas

THE time has come to put an end to the abominable nuisance caused by oil-burning ships discharging residue from their tanks or the high seas and within the harbors and ports of the world. This filthy mess is a nuisance in more ways than one. It is defiling many of the most attractive bathing resorts on the sea coasts of the world. It is endangering the shipping in our harbors because of the liability of the floating oil catching fire—something which has frequently happened with disastrous results—and now the public has awakened to the fact that it is causing a widespread destruction of the bird life of the seas. The floating refuse gums up the feathers and the wings of sea fowl to such an extent that they are unable to lift themselves from the water, cannot move about in search of food, and simply drift as starving derelicts until they are cast up by the thousand upon the beach.

Complaints of this nuisance have been growing in intensity and they are common upon both sides of the Atlantic—in fact, in all waters that are frequented by oil-burning ships. The matter can best be dealt with by an international commission, which should subject the nuisance to a thorough investigation and agree upon a code of laws which would make it as much an offense for a ship to discharge refuse on the high seas, or in any port or harbor, as it now is for any factory or domestic dwelling to deposit its refuse upon the streets or highways. We have sewage disposal and purification plants on shore, with an army of street cleaners, garbage carts, et cetera, to collect the daily refuse. It would be perfectly possible to install oil-separating apparatus on the ships, and maintain fleets of oil-refuse barges to receive the residue of the ships' oil tanks and decently dispose of it.

Motor-boat *Versus* Locomotive

THANKS to the demand upon the daily press reporter by the city editor that he make his story "snappy," the reporter, however much he would like to give the plain unvarnished truth, feels himself impelled to give a strongly dramatic or sensational touch to his record of any event that can by any possibility be worked up as a leading attraction in his paper's next edition. This was conspicuously notable in the account of the recent run down the Hudson River of Gar Wood's two fast motor-boats, in the attempt to beat the time of the Twentieth Century train. The facts were given; but they were written up in a way which has left the impression on the mind of the public that a motor-boat can beat a fast express over a race course of something less than 150 miles. Without in the least depreciating the very fine work done by the motor-boats, we feel it our duty to point out that this was in no sense a race, since the boat was under no restrictions as to speed, whereas the train was held down to its schedule. The *Baby Gar IV* made the trip from Albany to the Columbia Yacht Club, at the foot of West 86th Street, in two hours and 58 minutes.

It was the privilege of the editor, when the 20-hour train was first started some twenty years ago, to make the trip from New York to Chicago and back in the cab of the locomotive. In starting the final leg, from Albany to New York, the train was 29 minutes late, and with six cars of 352 tons total weight behind the locomotive, the engineer had to make up 29 minutes of lost time. Altogether, there were thirteen slow-downs for taking water, passing through stations and rounding curves where the side hill was being blasted out to straighten the track, and so on, and, consequently, by the editor's stop-watch timing, we ran for a great part of the distance at from 70 to 75 miles an hour. The train reached Grand Central station on time, and we passed through Spuyten Duyvil, 131.73 miles from Albany, where the train slowed down, at 9:15, having covered the distance in 131 minutes, an average speed of over 60 miles an hour. This was done with one of the old Atlantic-type engines. What could be done with modern engines of twice the power can be readily understood.

At one portion of the journey outward bound, stop-watch timing showed that we were making a speed of 84 miles per hour. If the modern express locomotive were in the racing business, even the very fastest motor boats of today could hardly keep a New York Central train in sight on that run.

This Time the Mooring Mast Failed

WHEN the *Shenandoah* broke away from her mooring mast, the latter pulled the metal nose cap out of the ship and held it securely aloft until it was taken down for inspection. When the *R-33* broke away she pulled so hard on the nose of the mast that she tore it loose. She carried the wreckage across the North Sea, and it was still hanging in place after the ship had fought its way back to the hangar. In each accident, it seems to have been a heavy side gust that caused the break-away, and the condition of the wrecked structures, in the one case on the ship and in the other on the mast, prove beyond disputation that the maximum stresses are not those which occur when the wind is blowing parallel with the axis of the ship but when it suddenly shifts and strikes it on either bow. A most interesting attempt to estimate these stresses was recently made by the Navy Department, in which the heavy, axial spindle at the bow of the *Shenandoah*, which was bent when the ship was torn away, was investigated. The amount of pressure necessary to straighten the spindle was noted and a figure, if we remember rightly, of about sixteen tons was arrived at as representing the lateral force exerted at the time of the break.

When the *R-33* returned it was noticed that a large section of her bow extending back to the second ring was broken, and it looked as though a much larger section of her bow had been torn away than was the case in the *Shenandoah* disaster. Details of the accident are not available at the present writing; but it is stated that after she parted from her anchorage the ship lurched forward and smashed her bow against the mast—an explanation which certainly does not explain.

Camille Flammarion

SOME of the sunlight passed out of the scientific world when Camille Flammarion went to his long sleep at the ripe age of 83. This great astronomer, for he was certainly that, was one of those outstanding scientists who, like Huxley, have the happy faculty of dressing profound scientific truth in the garments of everyday life, and casting upon it the light and sparkle of a rich and poetic imagination. What Huxley did for geology, Flammarion did for astronomy; and he paid the inevitable price. For popular science, no matter how accurate and truthful, is more or less anathema to the academic and university mind. We once asked America's leading naval architect to write a story for the Scientific American telling how he went about the task of designing a transatlantic liner. He immediately and flatly refused, saying that it cost far more time and effort to write such an article than it would to write on the same subject a strictly technical paper. "Writing down" in science is an art calling for an unusual and only too rare type of mind. If Flammarion gave his imagination too free a rein at times, it is nothing to his discredit and, in the judgment of posterity, will not dim his great reputation.

Born at Montigny-le-Roy on February 26, 1842, at the age of sixteen he became a student and assistant in the Imperial Observatory. While still a youth, he became editor of *Cosmos;* and in 1865 was scientist and editor of *Le Ciecle.* Three years later he made many balloon ascensions for scientific observations. This led to his being made Director of the Observatory of Juvisy-sur-Orge. He was a voluminous writer in many fields of scientific research.

"Spirit Return"

By J. Allen Gilbert, Ph.D., M.D.

"I approve of your suggestion to retain the envelope unopened and I continue the offer of $500 to any one who wishes to try further—until November 1, 1925."

J. Allen Gilbert

INVESTIGATION into "spiritualism" does not go far until it is confronted with both fraud and facts which we cannot explain if we are to accept them as stated. Somewhere there is ground for rational consistency if fraud and ignorance can be eliminated. That middle ground cannot be gained by dogmatic postulation of evident contradictions; nor can it be gained by the gulping down of unverified and unverifiable assertions without ground or reason. If "spirit return" is a fact, sooner or later it will be able to stand on its own feet without this eternal see-saw of "'Tis—'Taint." Investigation is the only means of settling the dispute.

Some seven years ago, after having worked at the problem of "spirit return" quietly by every possible avenue of which I could avail myself and after having failed to get anything through the most accredited scientific, semi-scientific and even pseudo-scientific channels at my disposal, I decided to approach the general public. The following letter was given to the *Morning Oregonian* of Portland, Oregon, and was copied rather widely through the channels of the Associated Press.

Portland, Oregon, May 30, 1922.

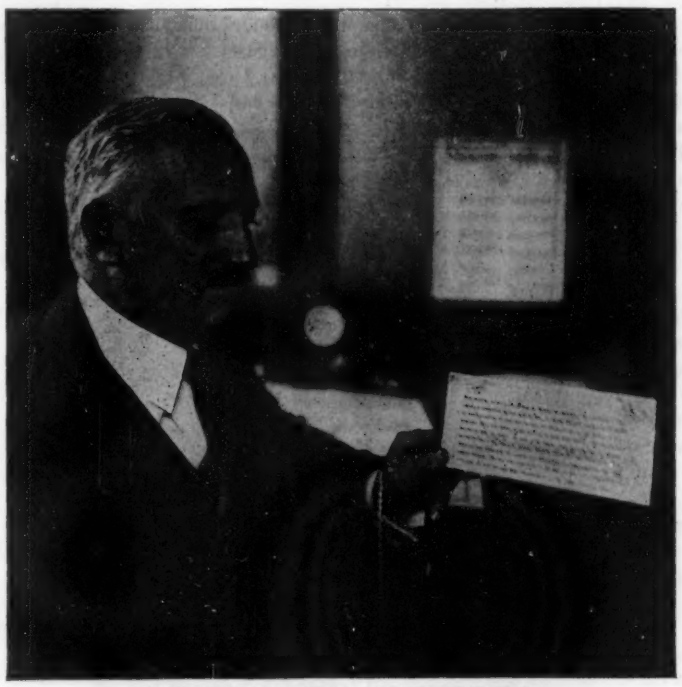
Mrs. J. Allen Gilbert (Florence A. Z. Gilbert) died December 17, 1917. For months previous to this time her death was a certainty. We were both deeply interested in psychology. Both also had friends who were firm believers in the phenomena of so-called spiritualism. Neither of us had ever had any experiences or found any data that left conviction as to the possibility of the "return of the dead." We felt sure that after her death messages would be brought to me from her friends who are believers along this line. In this I have not been disappointed. In order to get the affair on some sort of scientific basis, previous to her death she and I agreed upon a certain sign, countersign, password, code, or whatever one may see fit to call it, by which I might be able to recognize any communication from her as genuine in case such should be alleged. She was to make every possible effort to return but credence was to be given nothing by me unless accompanied by the countersign. Both of us deplored the enormous amount of fraud and deception that is practiced in this field.

Repeated messages, reputedly from Mrs. Gilbert, have been brought to me. In no instance have the transmitters of these messages been able to obtain the countersign, simple though it is. In some instances, long conversations with her have been reported but when the countersign is demanded nothing is forthcoming and the messages cease from that source. I might add that these messages, if genuine, bespeak a lamentable decadence of mentality in Mrs. Gilbert as compared with my memory of her.

This password or countersign was put in writing and placed in safe-deposit under triple seal. Attempts to reproduce it have been made through the most accredited channels for such phenomena, without avail.

In order to stimulate attempt in this direction, and thus push the experiment in every possible way, I hereby offer a reward of Five Hundred Dollars ($500.00) to anyone who will obtain that countersign by communication with Mrs. Gilbert. In order to aid in such attempts, I hold myself in readiness to help by submitting to any reasonable conditions that give promise of results.

(Signed) J. Allen Gilbert.



CAN THIS PASSWORD BE REVEALED?
The editor of the Scientific American holding the triply sealed envelope containing the countersign

Naturally, the most interesting phase of the correspondence which came to me as a result of this letter, is the fact that up to date there have been sent in one hundred and thirty-nine definite countersigns, all ostensibly from Mrs. Gilbert, all of them different (except three) and all of them wrong. This can only mean that each one, getting a message, got it out of his own subconscious or possibly out of a tricky conscious. With two or three exceptions the letters have the mark of sincerity upon them. The writers simply do not understand the phenomena they are getting. Aside from the nature of the letters as evidence of their sincerity, a moment's consideration will convince anyone that they necessarily must be sincere. The conscious fraud has nothing but trickery as his stock-in-trade and is not going to be so foolish as merely to guess when he stands but one chance in billions of striking the true countersign. To fail would be to undermine his fraud. Presumably, then, most of the messages are honest and sincere.

Most of the countersigns submitted were claimed to have been obtained directly from Mrs. Gilbert. Many of them described hallucinatory images of Mrs. Gilbert as she appeared to them to deliver her countersign to me through them. Minute details of her dress and general appearance were recited. These descriptions were usually so wide of the mark that they bordered on the ridiculous. Some of the countersigns were obtained by interested parties through the mediumship of professional mediums employed for the purpose. Others were obtained through the Ouija Board and still others through automatic writing, several splendid specimens of which are to be found in the correspondence. One such specimen was written ostensibly by Mrs. Gilbert from the planet Venus.

My name having been signed to the offer as "J. Allen Gilbert," a good many answers were based upon a false assumption as to my first name, accepting it from Mrs. Gilbert as John, James, Jimmie, Jim, only one hitting upon my true first name, namely, Joshua. This disclosure of "Joshua," which I never use as a rule, is of no significance for after twenty years I still continue to get some mail addressed to me as "Joshua A." due to my having foolishly yielded to the insistence of a Life Insurance Company that I should sign my full name to the application. Nor does Mrs. Gilbert seem to have any better memory as regards her own name than she has relative to mine. She signs it under various circumstances as Susan, Annie, Louisa, Aurora, Sunbeam, Pussy and Anna, all of which have no connection or application to her or her life in any way that I know of.

One of the newspapers in New England, when copying the letter, got my name "J. Albert" instead of "J. Allen." The former gave just as good results as the latter, Mrs. Gilbert never seeming to detect the error in the name.

Not one of the 139 countersigns submitted has the least resemblance to the real countersign, which will bear unmistakable evidence of its authenticity when revealed. One came in German which is not only misspelled but for my convenience is translated into "R. Yours." Mrs. Gilbert's knowledge of German was limited largely to reading though she could understand it poorly and speak it even more poorly. They certainly gave her a knowledge of the Bible which she did not possess when they reported her as quoting various Biblical references by book chapter and verse. One message was transmitted by Professor James whom I knew but slightly through his exchange lectures at Yale. Those who knew Mrs. Gilbert could certainly not imagine her saying, "Jim,

(*Concluded on page 143*)

Plumbing the Depths of Neptune's Secrets

Fables of the Sargasso Under the Acid Test of Science

By Albert A. Hopkins

Fellow of the American Geographical Society of New York

THE sea is the great father of romance and a home of marvels. Shakespeare in King Richard III. very well summarizes the matter in Clarence's dream when he says: "I saw a thousand fearful wrecks; a thousand men that fishes gnaw'd upon; wedges of gold, great anchors, heaps of pearl, inestimable stones, unvalued jewels, all scatter'd in the bottom of the sea."

The subject of oceanography is an important one, and one which is interesting to everyone. The newest expedition, under the auspices of the New York Zoological Society and led by Dr. William Beebe, has attracted great attention, as the aims of the explorers have been focussed on several very important things, such as the Sargasso Sea, the Humboldt Current, and the weird Galapagos Islands.

Modern newspaper science is one thing, while the results of an expedition published two or three years after is another, therefore, the *Arcturus* was equipped with powerful wireless transmitting apparatus in order that the readers of our great metropolitan newspaper, *The New York Times*, could be informed daily (static permitting) of the adventures and discoveries of the band of men and women scientists that formed the expedition. We shall not concern ourselves in this article with the discovery of two volcanoes erupting in Galapagos, or with the big tide rip where the Panama and Humboldt Currents meet, but will consider only the Sargasso Sea.

The "Lost" Continent of Atlantis

Say what you will about the Beebe Expedition to explore the fabled Sargasso Sea, one great thought exists in the lay mind. Will there be any discoveries by these argonauts of science which will tend to substantiate the story of Atlantis? We are afraid not, for the oft-discussed lost continent below the lazy weeds of the Sargasso Sea probably never existed.

Atlantis was the creation of old and inaccurate chroniclers who gathered and warped miscellaneous data of history and physical phenomena. All the stories of the powerful capital as outlined by Plato are now believed to be pure fabrications. If, however, you still want to believe that this lost continent did exist, you can read Ignatius Donnelly's "Atlantis," for this almost forgotten author was a most convincing writer. Sea lore teaches us that the Sargasso Sea is indeed the "Port of Missing Ships," the "Ocean Graveyard" or "Davy Jones's Locker," for under the sluggish weeds are triremes, caravels, galleons, windjammers and tramp steamers.

It is not only to the classical authors to whom we owe a mass of misinformation on this subject but we find that such a charming writer as T. A. Janvier who wrote in 1896, added to the confusion.

Sir John Murray, the famous English ocean explorer, says: "The famous Gulf Weed characteristic of the Sargasso Sea in the North Atlantic belongs to the brown algæ. It is named *Sargassum bacciferum*, and is easily recognized by its small berry-like bladders. * * * It is supposed that the older patches gradually lose their power of floating, and perish by sinking in deep water. * * * The floating masses of Gulf Weed are believed to be continually replenished by additional supplies torn from the coasts by waves and carried by currents until they accumulate in the great Atlantic whirl which surrounds the Sargasso Sea. They become covered with white patches of polyzoa and serpulæ, and quite a large number of other animals (small fishes, crabs, prawns, mollusks, and so on) live on these masses of weed in the Sargasso Sea, all exhibiting remarkable adaptive coloring, although none of them belong properly to the open ocean."

From antiquity down through the Middle Ages, the ocean region westward of the Azores was called the "Sea of Darkness." It must, indeed, have been a fearsome task for Columbus to guide his little fleet through the waters so unlike the clear Mediterranean. His sailors were naturally terrified, for they could not conceive of seaweed without rocks, so to assure them, records show Columbus hove the lead line, and found no bottom.

The name was originally "Sargaco" now changed to Sargasso and was derived from a word meaning "Sea of Little Grapes" referring, of course, to the berry-like bladders noted above in our quotation from Sir John Murray.

It is perhaps unnecessary to state that the Sargasso Sea lies between the United States, the Greater and Lesser Antilles and the West Coast of Africa. The North Atlantic area of the Sargasso Sea is about

SCIENTISTS ON BOARD THE ARCTURUS

Dr. William Beebe is showing some of the finds to the members of the expedition of the New York Zoological Society

half that of Europe so it is to be seen that the *Arcturus* has considerable territory to cover.

We also show interesting sketches from the *Illustrated London News* and some of the actual photographs taken on board the *Arcturus*.

The area of the maximum distribution of weeds is an elliptical tract with the clockwise-moving circuit of the North Atlantic Drift Current. The impediments to the progress of vessels is possibly due as much to the absence of wind as the presence of weed in the calms of the Horse Latitudes. Surrounding the ellipse is a well-defined oval ring in which the weed is more thinly distributed; and outside of this, another space with even more scattered distribution. Many of you have gone to Bermuda probably without knowing that these charming isles are within the confines of the Sargasso Sea!

The distribution of seaweed is shown by the map which indicates three belts. In the region of greatest abundance the surface of the sea is covered with the weed to the extent of from ten to twenty-five percent. In the next belt the amount is between five and ten percent, while in the outermost rim the dwindling distribution does not rise above one percent. As floating chaff or cork to which a circular motion has been given in a basin crowds together toward the pool where there is the least motion, so does the Sargasso weed tend to collect in the calmer tract within the circuit of the North Atlantic drifts.

We must not suppose that all the detached weeds find their way into the seaweed meadows. The coasts of France or Great Britain show evidences of the distance to which these escaping weeds may be carried. A bunch of weed detached from the Bahama Islands would make the passage to Cape Hatteras (six hundred sea miles) in about a fortnight at an average rate of two miles an hour. The farther passage to the Azores would require about six months.

Once drawn into the Sargasso Sea, the weed has a new future opened to it, because here, especially in the most densely weed-covered part which roughly coincides with the region of frequent calms, the meadows are rarely disturbed save by an ocean swell—the reflection of some distant storm. Life swarms in this meadowy sea, and the Sargasso weed lives on until overcome by the decay of its buoyant bladders, when it slowly sinks into the depths of the ocean and gives place to a fresh supply floating in from the encircling path.

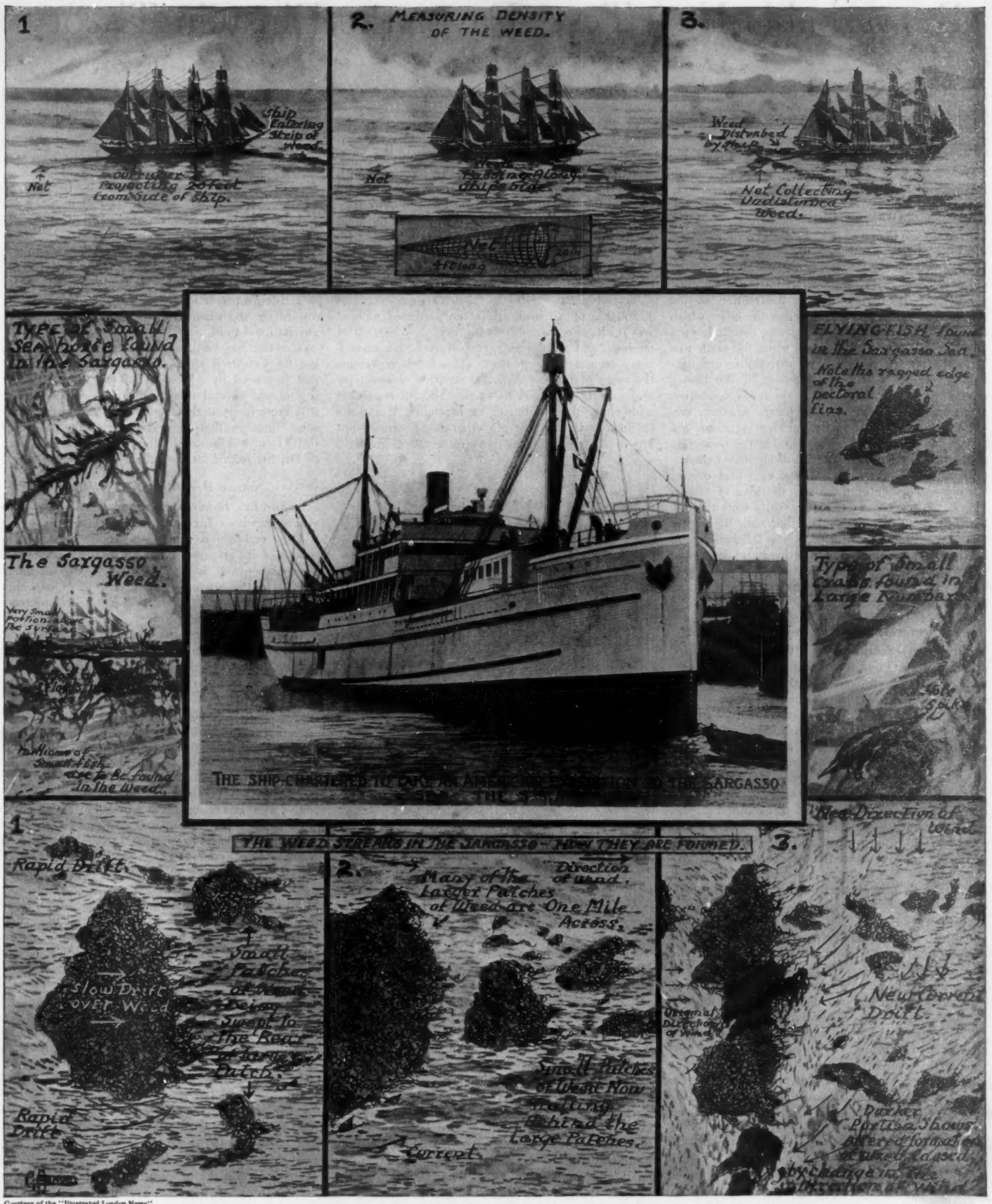
Vast Islands of Seaweed

Some idea of the quantity of weed that must be afloat over the surface of the Sargasso Sea may be gained from experiments made in recent years. A net with a mouth twenty inches wide was suspended from a long outrigger for a period of two hours when six sea miles were traversed and thirty-five pounds of weed were secured. This would give about ten tons to the square sea mile. Other tests have shown as high as eighteen tons per square mile.

Where the northeast trade winds blow, gaging by these measurements, the amount might be five tons to the square mile and in the calms of the Horse Latitudes perhaps as much as forty tons. The greatest amounts are nearly always visible in calm weather when it collects in "islands" several hundred yards in diameter with clear water between them. In every large patch of weed there is flotsam and jetsam in which, to quote the Ancient Mariner, "slimy things do crawl upon a slimy sea!"

It is an eerie feeling that creeps over the beholder on a dark, clear night when myriads of stars are reflected from the glassy surface of this sea and the floating islands of weed rise and fall in long, low swells as if through the respiration of some gruesome monster lurking under the sea.

The Sargasso Sea demonstrates the capacity of nature to fit the living to an environment such as surrounds the specialized life of the ocean abysses. Here we must leave this fascinating topic for its ramifications deal with oceanography, natural history, botany and geology. It is indeed a wonderful area, and we marvel at the courage of Columbus, who led the *Santa Maria*, the *Pinta* and *Nina* across this mysterious trackless, treacherous area.


1
Ship entering Strip of Weed.
Net
Outrigger Projecting 20 Feet from Side of Ship.
2. MEASURING DENSITY OF THE WEED.
Net
Weed Passing Along Ship's Side.
Net
4 ft long
20 in
3.
Weed Disturbed by Ship
Net Collecting Undisturbed Weed.
TYPE OF Small SEA-horse found in the Sargasso.
THE SHIP CHARTERED TO CARRY AN AMERICAN EXPEDITION TO THE SARGASSO SEA
FLYING-FISH found in the Sargasso Sea. Note the ragged edge of the pectoral fins.
The Sargasso Weed.
Very Small portion above the Surface
Millions of Small Fish are to be found in the Weed.
Type of Small Crabs found in Large Numbers
Hole for Bolt
THE WEED STREAKS IN THE SARGASSO - HOW THEY ARE FORMED.
1
Rapid Drift.
Slow Drift over Weed
Small Patches of Weed being Swept to the Rear by Current.
Rapid Drift
2.
Many of the Larger Patches of Weed are One Mile Across.
Direction of Wind.
Small Patches of Weed Now Floating Behind the Large Patches.
Current
3.
New Direction of Wind
Original Direction of Wind
New Current Drift.
Darker Portion Shows Altered Formation of Weed caused by Change in the Direction of Wind

Courtesy of the "Illustrated London News"

ARGONAUTS OF SCIENCE SEEK THE MYSTERIES OF A MARINE AREA HALF THE SIZE OF EUROPE

This "Port of Missing Ships," this "Ocean Graveyard" affords a happy hunting ground for naturalists with leanings toward oceanography. The Arcturus is the latest vessel to explore these eerie depths under the leadership of Dr. William Beebe of the New York Zoological Society. Our engravings show the method of measuring the density of the weed, some of the flora and fauna of the sea and how the movement of the weed makes and breaks vast patches. Drawn by Mr. G. H. Davis from material by Capt. C. C. Dixon, F.R.G.S.

Remarkable New Tests Favor the Einstein Theory

By Henry Norris Russell, Ph.D.

IT is unusual, even in this age of scientific activity, to have three independent investigations in an important field reported at almost the same time. Yet this has recently happened, and the question at issue is the widely discussed one of relativity.

First among them we may take the recent work of Professor Michelson and Professor Gale of the University of Chicago—which deals with a subordinate, but very important, phase of the problem. We all remember how Michelson and Morley, many years ago, made their famous experiment, designed to detect "ether-drift"—that is the motion of the observer and his apparatus through the ether which carries light-waves. No effect was detected, even at different seasons of the year when the earth was certainly moving in different directions, and this led by degrees to the development of the theory of relativity, according to which the very constitution of nature is such that no experiment whatever can tell whether the observer and all his apparatus are at rest or all are moving together at the same rate and in the same direction. But alternative explanations were possible—they always are—and one of the most plausible of these was the idea of "ether-drag." According to this, any solid and massive body in some way drags the ether with it, leaving that at a distance unaffected. Now Michelson and Morley set up their apparatus in an underground room so it is conceivable that the ether within this room was dragged along with the earth, and that this accounts for their result.

Apparatus Set Up in a Vacuum

The recent experiment tests this possibility in a different way. Four mirrors are set up at the corners of a rectangle so that light is reflected from one to another and returns to the starting point. By the familiar device of a half-silvered mirror, a beam of light is divided into two parts, one of which goes around the circuit "with the sun" and the other "against the sun." The two beams are then brought together, and produce interference fringes.

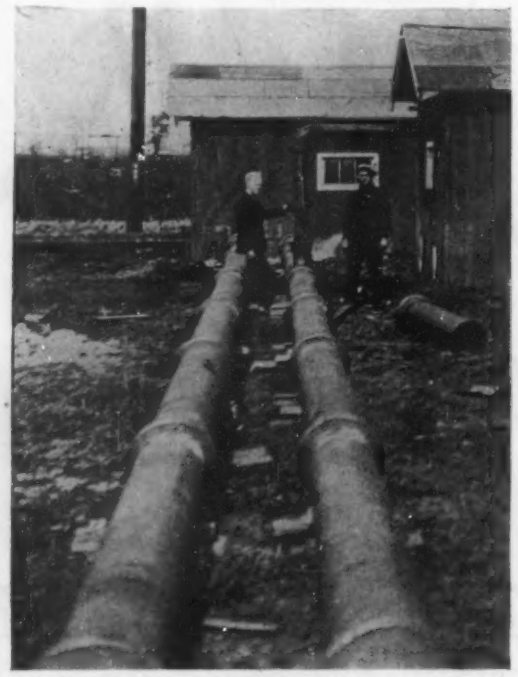
If the earth were at rest, the two beams would take exactly the same length of time to make the circuit, and the fringes would be found in a certain standard position. Uniform motion of the whole earth—such as its orbital motion about the sun practically comes to—would make no difference in the times of the two beams, whether on the ether-drift, ether-drag or relativity theories. But the earth's rotation is a different matter. The beam that goes around with the sun finds the earth rotating to meet it—each of the four mirrors advancing by a minute amount as the light travels toward it, while the beam going against the sun finds the mirrors retreating. The latter, therefore, take longer to make the circuit, and come in late, displacing the fringes.

This is the effect to be anticipated on the old, or ether-drift theory, and the theory of relativity also predicts a positive result, for in this case all four mirrors are moved in *different* directions by the earth's rotation. Detailed calculations show that the two theories predict exactly the same shift, which comes out proportional to the area enclosed by the path of the rays. On the ether-drag theory, however, the ether should share the earth's rotatory motion, and there should be no shift at all.

To get a reasonable shift, the enclosed area must be large, and its perimeter at least a mile. Experiments made at Mt. Wilson in the open air showed visible fringes, but these were so much disturbed by the effects of varying density of the air, that no good measures could be made.

So Professor Michelson—always resourceful—set up his apparatus near Chicago, put it on level ground, and in a vacuum. Long lines of twelve-inch pipe were laid, connecting the piece on which the mirrors were mounted, and a powerful air-pump reduced the pressure inside them to little more than one percent of that of the outer air, so that the light on its long circuit of more than 6,000 feet met with less disturbance than in 100 feet of common air. Under these conditions, the images were steady, and good measures could be made.

The observed shift was 0.230 "fringes" or just 1/200,000 of an inch, while the predicted amount was 0.236, the difference being over 1/7,500,000 of an inch, and within the errors of even this exceedingly accurate measurement. This result represents the mean of no less than 269 separate observations and may be regarded as final. Though consistent with either the old theory or Einstein's, it appears to dispose of the idea of "ether-drag," and to put one of the rivals of relativity quite out of court.



THE SPECTACULAR EINSTEIN PIPE EXPERIMENT

Two rays of light racing in opposite directions around this one-mile rectangle did not come back together, thus favoring the Einstein Theory

The second investigation is a repetition of the Michelson-Morley experiment, by Professor D. C. Miller. Having already confirmed the negative result obtained in the underground vault, Professor Miller, to test the ether-drag hypothesis, set up his instruments on the top of Mount Wilson—in a building as light as is consistent with proper protection of the apparatus.

A long series of measures here, after laborious clearing out of spurious effects, leave outstanding a clearly observable fringe-shift—not as large as would be required by the old theory, but very similar in nature. By themselves, they would indicate a partial ether-drag, as if the ether on the mountain top was partly, but not entirely, dragged with the earth in its motion. In view of Michelson's experiments, this explanation appears to the writer very dubious. It is very hard to see how the two sets of results can be reconciled.

In the present case, in spite of all the careful precautions taken, the existence of such still-elusive errors appears to be more probable in the second set of experiments; for the very condition that they be made in as light a housing as will protect the very delicate apparatus from the disturbing influence of differences of temperature, magnetic forces, and so forth, renders them more subject to residual disturbances than the observations made in an underground chamber.

The third observation is the more definitely astronomical of the three, and is reported by Dr. Adams from Mt. Wilson. It deals with the third of Einstein's predictions—the shift of spectrum lines toward the red when they are produced in a strong gravitational field.

This test has been applied to the solar spectrum but the predicted shift is small—corresponding to that produced by a velocity of 0.6 kilometers per second and several other influences—some of them still imperfectly understood—affect the positions of solar lines so that the existence of the "Einstein shift" though indicated by the long and careful work of Dr. St. John is still doubted by some observers.

Nature Provides Decisive Test

Nature has, however, been very kind to us—providing us with a far more decisive test. Sirius has a faint companion star—only about one-ten-thousandth of its brightness, though of forty percent of its mass—which is one of the most remarkable objects in the heavens. Though it gives out only about 1/300 as much light as the sun, its spectrum is of the F type, indicating a temperature a good deal higher than the sun's and a greater brightness per square mile. On this basis Eddington calculates that its diameter should be only one-thirty-fifth that of the sun or hardly more than three times that of the earth—but this means that the star's density should be fifty thousand times that of water.

Till last year this seemed absurd, but Eddington showed them that in the inside of a star, where the outer portions of the atoms are stripped off, the remaining fragments of atoms should be capable of being driven very close together by great pressure, so that even this enormous density is quite believable.

But, if this star is so small and massive the Einstein shift (which is proportional to the mass divided by the radius) should correspond to a velocity of fully 20 kilometers a second and be measurable.

The spectrum has been photographed several times at Mt. Wilson, in spite of the great difficulties caused by the close neighborhood of Sirius, and the radial velocity measured. Fortunately, the value to be anticipated can readily be found by correcting the velocity of Sirius itself for the orbital motion of the companion, and is accurately known. The observed velocity comes out more than thirty kilometers too great—corresponding to a shift of the lines to the red in the direction predicted by Einstein, and to an even greater amount than Eddington calculated.

It appears, therefore, that the trend of Einstein's predictions is at last decisively verified and that the companion of Sirius is even smaller in diameter than Eddington's calculations (which in such a case can at best only be approximate) made it. The existence of stars of enormously high density is confirmed; and the observational evidence in favor of all three of Einstein's predictions is now so strong that in the writer's opinion, at least, there is no good reasons for regarding the substantial correctness of his principles as any longer in doubt.

J. E. Haynes, St. Paul

How the True Cattalo Is Bred

GREAT scientific interest attaches itself to the work being done by the Canadian Government in breeding hybrids at the great Buffalo Park, near Wainwright, in Alberta. In this breeding work, Hereford, Shorthorn or Aberdeen-Angus cows have constituted the foundation females and purebred bison bulls the males. The offspring is called a hybrid buffalo. The product of two hybrids has been designated as cattalo, and this term is now generally accepted by stockmen.

George F. Paul

A TRUE CATTALO

The offspring of two hybrid buffalo

In the hybrid and true cattalo are many outstanding characteristics that are highly desirable. First of these must be placed the hide. This is very similar to that of the buffalo in quality. The hair is thick and the hide has great warmth. Robes made from such hides have long, thick hair that possesses a beautiful curl and luster. Any settler living in the prairie provinces of Canada would certainly appreciate the qualities of such a robe.

Then in the second place, cattalo are remarkably rugged. They are specially fitted to weather the terrific gales that seem to have their origin in the Medicine Hat region. Such cattle face the storms instead of drifting with them, as do the domestic cattle. They are far better able to resist the inroads of disease.

In the third place, these animals are like the bison in that they are able to forage and thrive on pasture that might mean starvation for a domestic cow. During the winter they nuzzle down through the snow and get feed. They do not require shelter.

Such are the desirable features of the new types. However, Nature has gone to a great deal of trouble to make sure that a buffalo shall remain a buffalo and a domestic cow a domestic cow. There are barriers between them that are almost insurmountable, as the men in charge of the breeding work have found out. Most of the male calves are born dead. Often the cow herself succumbs. Or even if the male calf lives, it is likely to prove infertile.

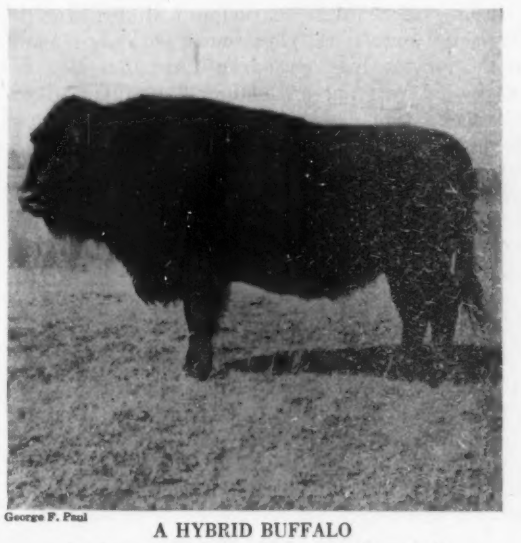
One great difficulty to overcome has been to get adult bison bulls to associate with cows of alien blood. Here has been the solution. Buffalo calves have been kidnapped and placed with domestic cows. When a domestic cow is first introduced to her foster bison son she nearly does a double handspring with excitement. Later, through the efficacy of linseed oil and the help of Father Time, family matters are adjusted and the foster son is in good standing. It has been found that bison and domestic calves that are raised together from calves readily consort later in life.

George F Paul

THE BUFFALO'S FRIEND

James Wilson, in charge of animals used in hybridizing

So much for the mating of bison and cattle. Now a new angle of the experimental work should be touched upon—the inclusion of the Asiatic yak in the breeding program. It has been found that the yak crosses readily and safely with domestic cattle. The yak appears to be the missing link between bison and cattle. The yak is about the same size as the Aberdeen-Angus. It has a mane-like fringe along the flank, long hair on the sides, and a tail much like that of a horse. It is free from disease, and has proved itself a wonderful ranger, withstanding hard winters without any shelter. A successful cross has been made of a yak sire and a bison dam. As this cross was not accompanied by abnormalities, the indications would support the theory that the yak holds an intermediary relationship between the bison and the domestic.



George F. Paul

A HYBRID BUFFALO

Product of a domestic cow and a bison bull

Naturally this work of producing new types is slow at first, but as the calves reach maturity there is far greater hope that in the not too distant future beef animals with bison blood in their veins will be feeding on the great stretches of the prairie provinces where winters are long and severe.

Contact and Refueling Now Accomplished In the Air

By Major H. H. Arnold, United States Air Service

AFTER the Wright Brothers made their first flight in an airplane on December 17, 1903, both airplane and engine designers endeavored to perfect these aerial vehicles by increasing their radius of action so that they could be universally used with the same degree of success as the existing modes of transportation. In the beginning it was a long struggle between the engine builders and the plane designers for, as rapidly as the plane designers increased the efficiency of the planes to such an extent that they utilized the full power of the engines, another engine would appear with greater horsepower and a lesser weight-power per ratio and the struggle was on again.

In any successful aerial venture and also in military aerial operations, planes must not only remain in the air for long periods of time, but also be capable of carrying an additional useful load of passengers, mail, express, or bombs and ammunition. To accomplish this, some new, at present unknown, device or change in shape and structure of existing types or an entirely new motive power must be developed which will give much greater power with a corresponding decrease in the weight of the engine and also in the fuel it consumes.

No Precedents to Follow

In the meantime people everywhere are endeavoring to increase the radius of action of existing types. Thus it was that the idea of making contact between airships germinated and was tried out at Rockwell Field in the Spring of 1923. As is usually the case in advances that are taking place daily in aeronautics, there were no precedents to follow. The idea itself was simple—send up one plane and send another up when needed, carrying gas, oil, water or food to be transferred to the duration plane. In carrying out the idea, however, the procedure was not so simple. The first requirement was to get two pilots who were so well trained that they could synchronize their flying perfectly.

The next step was the development of systems in the two planes, one for sending gas or other supplies down and the other for receiving such supplies when they came within reach. This step was purely mechanical and no difficulties were encountered. To convey the gas, oil and water from one plane to the other, a 40-foot, metal lined, flexible, one-and-a-quarter-inch steam hose was used. The method of procedure was to drop the hose from one plane and let it hang while the plane continued on a straight, horizontal flight. In the meantime, the duration plane would come under in such a position that the man in the rear seat could reach out and get the end of the hose, insert the end into opening of a tank, open a valve and, after getting sufficient supplies, turn the hose loose.

Contact Made with Ease

Two preliminary trials had demonstrated beyond question the practicability of the experiments, so that unqualified success was expected when Lieutenant Lowell Smith, Commander of the round-the-world flight and Lieutenant J. P. Richter left the ground at Rockwell Field at 5:04 A.M., August 17, 1923. So certain of success were the crew working on the ground, that a schedule for transferring supplies was made up in advance and, it may be remarked, was actually followed as planned.

The schedule was:

10:00 A.M. Transfer of 90 gallons of gas
12:00 Noon Transfer of lunch
2:00 P.M. Transfer of 90 gallons of gas
4:00 P.M. Transfer of 90 gallons of gas
4:30 P.M. Transfer of 15 gallons of oil
5:30 P.M. Transfer of 90 gallons of gas
6:00 P.M. Transfer of supper
6:30 P.M. Transfer of as much gas as they would take.

Following day:

Daybreak Transfer of 90 gallons of gas
7:00 A.M. Transfer of breakfast
8:00 A.M. Transfer of 90 gallons of gas.

For the remainder of the day adhere to the schedule of the previous day.

The ease with which the two planes made contact was remarkable and, before the first day's flight was finished, the two sets of pilots had become so adept that a plane would leave the ground, make contact, deliver 90 gallons of gasoline and be back on the ground in 15 minutes. Lieutenants Smith and Richter were amply supplied with substantial hot food while on the flight.

During the first day everything went according to schedule; but on the second morning there was a low-hanging fog that permitted a ceiling of only about 200 feet being reached at the clearest points and fifty feet at many other places. As a matter of fact, the two planes refueled while they were not over fifty feet above the water. The gas had just been transferred when they ran into a fog bank and were forced to separate.

Later the fog cleared and the other contacts were made without any trouble.

Troubles did not come singly and preparations cannot always be made in advance to meet every emergency. About the middle of the morning, as Smith was turning north from the Mexican border, his engine started missing badly. Smith at once correctly diagnosed his trouble as a stoppage in the gas line. At first it seemed that nothing could be done; but necessity is the mother of invention. The country that he could reach for a forced landing was so rough that he surely would have crashed if he went down. He grabbed the only thing in sight, a flashlight, hit a three-way valve in the gas line, smashed the light, but cleared the line. The engine took hold again and the plane missed the rocky cliffs alongside of a canyon by inches; but they were clear and on their way again.

When they landed on August 26, 1923, at 6:19 P.M. they had broken all existing records for speed and duration for over 2,500 kilometers, remained in the air for 37 hours and 15 minutes, and covered a distance of 3,293 miles at an average speed of 88 miles per hour. During the flight they had received from the ground 687 gallons of gasoline, 38 gallons of oil and had served to them four hot meals.

Refueling Accomplished Against Odds

This proved conclusively that an airplane could be kept in the air over a station until the engine, plane or pilot were out; but did not prove the practicability of the method at other than specially prepared stations. Following this success, plans were made for a refueling trip from the Canadian to the Mexican borders. For this purpose, Smith and Richter left Sumas, Washington, at 6:30 A.M. one morning in October, 1923. After circling over the Canadian border, they headed for Eugene, Oregon, some 372 miles away. At Eugene they were met and, while continuing on their course, given a load of gasoline. At Sacramento, California, 440 miles from Eugene, they were again met in the air and given another load of gas. That evening, at 6:43 P.M. they crossed over the Mexican border, 1,297 miles from their starting point. This proved beyond any doubt the practicability of making contact and delivering fuel in the air under any and all circumstances. They had refueled in fog, over strange places, while crossing over mountain ranges in Oregon and while over the long, smooth Sacramento Valley.

For many reasons, it was most desirable, if pos-

sible, to be able to take planes up in the air attached to dirigibles, cut them loose and let them continue in flight under their own power. The natural sequence to this, to have the plane return to the dirigible and re-attach itself to the dirigible was just another step.

The first attempts along this line were carried out at Dayton, on October 8, of this year. A small plane, piloted by First Lieutenant C. V. Finter, U. S. A., was taken up in flight while attached to the Army dirigible TC-3. As the Army had only small non-rigid types in their service, the largest having only 200,000 cubic feet capacity, it was necessary to take up a small plane; but the experiment itself would prove the practicability of taking up any size plane, provided a sufficiently large dirigible was available.

Weight of Planes Not Felt

The dirigible left the ground, climbed to an altitude of 2,500 feet, and then the pilot of the plane started his engine and cut the plane loose. There had been much discussion as to what would happen to the dirigible when it suddenly lost that much weight. However, the pilot of the dirigible never knew that the plane had been cut loose until he saw it circling under him. It was comparable to the loss of weight in the transfer of fuel, during which the pilot of the upper plane could not tell that he was losing weight with the transfer of gas, although he was losing it at a rate of about 150 pounds a minute. As for the pilot of the plane which had been cut loose, both plane and dirigible were attached and accordingly were moving at the same rate of speed. This speed was slightly in excess of that required to keep the plane in flight so that, after heading the plane down until he was clear, there was no difference between that flight and any other one.

The next stage of the experiment was to attach a plane to a dirigible while both were in flight. There was no doubt in the minds of anyone, who had given the matter a thought, that this would be a simple matter provided the necessary quick attaching device was available. The maneuvering for position for attaching was simple—but could a pilot maintain that position while he was endeavoring to attach the plane to the dirigible? That was the question.

Fortunately, the matter had been given some thought before and the necessary mechanical devices were ready for use. The flight was made at Scott Field, Belleville, Illinois. The same dirigible and plane were used as before. The dirigible went up

International News Reel

HOSE ATTACHED TO PLANE

Through a nozzle of 40-inch hose, 50 gallons of gasoline may be sent up in two minutes, or about 10 gallons of oil in three minutes

and flew a straight course at an altitude of about 2,400 feet. In the meantime, the plane maneuvered for position until the pilot attached the coupling device and then stopped his engine. The feat was accomplished.

Great Increase in Cruising Ranges

Thus the cycle of closely allied experiments is completed and they all have for their object the same end—to increase the cruising ranges of planes by external means. Heavy bombers with their full load of bombs can now leave small airdromes and, after getting into the air, take on their full supply of gas and continue on their flight. Thus, they will be able to take advantage of their full radius of action where formerly they could only partially fill their tanks when they took off with a full load of bombs. Torpedo planes, which now have difficulty in leaving the water, especially when it is glassy, can leave the water with the 2,000-pound torpedo and a small quantity of gas. After getting into the air they can be refueled and continue on and operate at points over 200 miles from shore; whereas formerly they were limited under some conditions to points only 75 miles away.

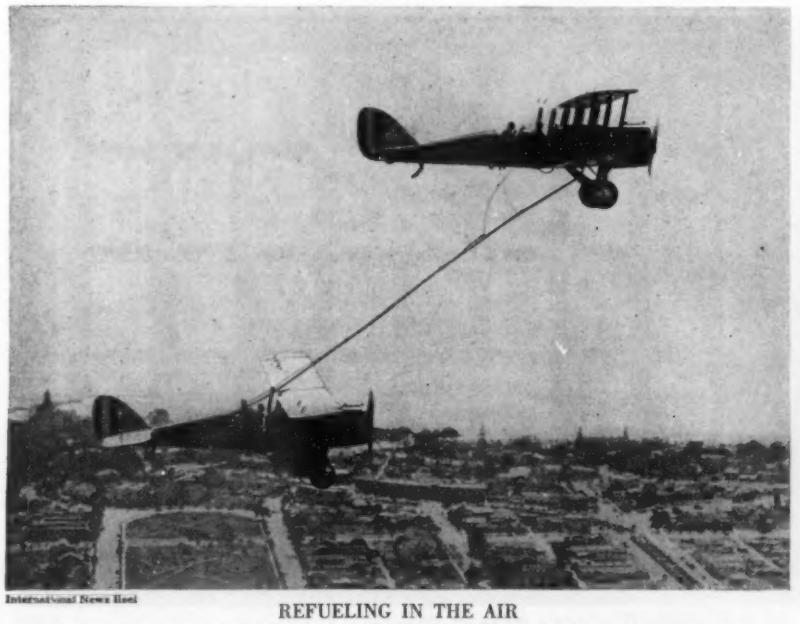
Commercial planes on long transcontinental trips can be refueled in the air and make trips with full loads without landing. This means a saving of several hours in the arrival of the plane at its destination, and it might very well mean the difference between landing at the destination before or after dark.

Combination of Dirigible and Plane Ideal

For a long time it has been a question as to the best method of patroling, with planes or dirigibles, long stretches of our coast-line, where, in time of war, there could be no attempts at landings made and yet, on account of the uncertainties of war, the coast-line must be patroled. It does not seem quite economical to maintain a network of airplane patrols when their services would be of so much value at other places. Consider, then, a dirigible of over 5,000,000 cubic feet capacity, with fifteen planes attached, assigned to the patrol. The dirigible can operate over a thousand miles out at sea. It can locate any vessels approaching the coast while they are many miles away and before they can see it. It can also radio into the shore stations the strength, composition and location of these surface craft while they are still three or more cruising days from shore. Now, consider a fleet of planes dropping from the dirigible, circling over the ships on the water, dropping bombs, raking the decks with machine-gun fire, meeting the hostile planes as they are launched, one at a time, and destroying them. The combination of plane and dirigible seems to approach the ideal. The large dirigible is a moving airdrome, it moves where it is most needed and then launches its planes, thus adding over a thousand miles to their cruising distance.

This method of operating may be carried much farther. A fleet of these dirigibles might be sent out for offensive operations, some carrying pursuit planes, and others bombing planes. All would be fully equipped and ready for action. When such a fleet approaches the hostile objective, the planes will be launched, the bombardment planes for destruction and the pursuit planes for their protection. These planes will fly to their objective and, after carrying out their mission, will return to their elevated airdrome.

Thus the war in the air is carried beyond the limits placed upon it by the theoretical radius of action of the planes and everyone must be prepared for it. It is unquestionable that future warfare will be vitally affected by this new method of operation.



International News Reel

REFUELING IN THE AIR

Lieutenants Smith and Richter in lower plane and Hine and Seifert in upper plane, flying over Coronado, California

International News Reel

AIRPLANE SUSPENDED FROM TC-3

Photograph taken just after the plane had flown up and attached itself to the dirigible at an altitude of about 2,500 feet

A Record of Achievement

By William I. Wyman

Principal Examiner, Patent Office

THE startling proportion of revolutionary inventions created by Americans since the modern American patent system was founded is neatly and strikingly exemplified in a simple but graphic exhibit that has just been installed by the officials of the United States Patent Office. On a large bulletin board in the main rotunda of the building are mounted about seventy-five printed copies of United States patents granted to American inventors for contributions of fundamental importance and of primary character. They embrace endeavors which on the whole have had a greater social and industrial effect on civilization than those of any other country during the same period. They comprise particularly those advances in applied science which especially distinguish our present civilization.

Electrical energy for communication and in the industrial arts was first applied on a large scale in this country and far above all other countries is America's lead in electrical invention. The telegraph and the telephone were the first notable commercial utilizations of the electrical current, while the electric light started the modern electrical age of power, heating and lighting.

Another department in which the United States shines even more preeminently, and which characterizes American industrial life more peculiarly, is in the invention and use of labor-saving devices. These are what distinguish American industry above all other differences and are mainly responsible for her disproportionately huge productive capacity. It is the labor-saving device that has made the United States so enormously wealthy, placed such a large number of its population in a position of material well-being, and provided its wage earners with an earning capacity of about three times that of its nearest European competitor.

They cannot in the small space devoted to the display, include examples of the tremendous strides made in automatic machinery since the beginning of the present century. In paper bag making, rolling mill practice, foundry operations, steel production, and most especially in automobile manufacture, have been devised machines of wondrous intricacy which with unbelievably skillful automatic operations carry forth manipulations of complexity and sensitive nicety, and with unimaginable increase of production.

In three industries examples are given of the introduction of automatic machinery which have quickened their processes so tremendously as to occasion large social consequences and to be equivalent to the introduction of new arts. In steel making, machinery has largely supplemented or displaced manual labor, making it possible to double or triple output with a practically stationary force in the last quarter century.

Shoe machinery has made production of footwear almost an entirely automatic affair, while inventions in the automatic production of glass bottles, sheet and cylinder ware in very recent years have not only marvelously increased the output, but have eradicated methods of manual production which have a history of thousands of years behind them and which a short time ago could not be conceived to be carried through by machine procedure.

Progress Based on these Patents

Recently, for the first time in the history of inventive endeavor, applied science has entered the field of romance. In the phonograph, the motion picture and radio, the amusements of the entire world were simultaneously and radically reorganized. With the exception of that occasioned by printing, all the variations in the social changes that have occurred since the beginning of recorded history have not equalled in telling effect the result made upon the purely domestic habits of the world's population by these few inventions. Their economic importance is correspondingly heavy, but it will take years to properly appraise it, as their ramifications are so diversified and their effects so indirect.

The typewriter, the cash register, the vacuum cleaner, the safety razor, are all so typically "Yankee" as to be readily recognized as such, and these contributions of universal convenience need no further comment.

For certain other activities, such as chemistry and warfare, Yankee genius is not supposed to be especially adapted, and yet outside of coal-tar products, America's creations are the most notable in chemical products and her contributions to the art of warfare are second to none. Vulcanized rubber is the most valuable product that has ever resulted from a single act of invention. To enumerate the revolver, the machine gun, the turret, the improvements in the submarine and the airplane, is enough to substantiate America's primacy in this field.

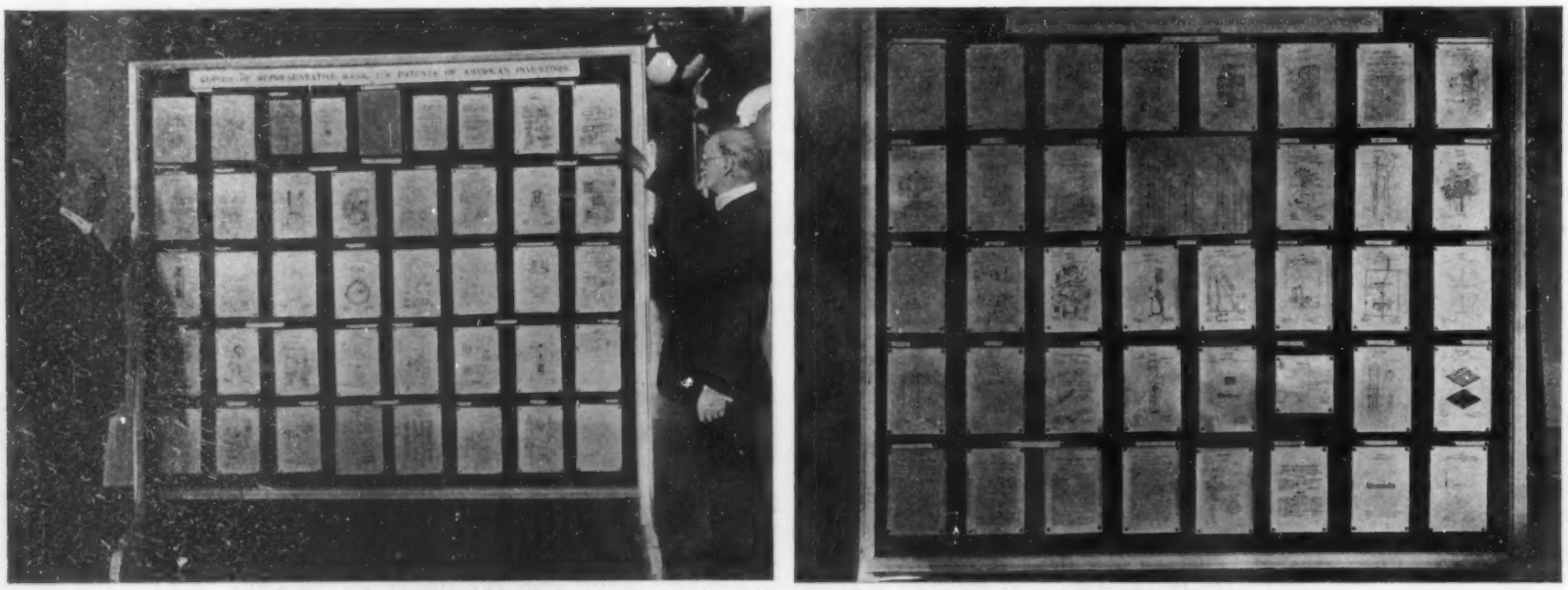
As to the airplane, an essay could be devoted to its coming possibilities. It has added a third dimension to transportation and thus infinitely multiplied the rights of way over all other modes of travel. Without entering into the controversy now raging, this much is certain: it has injected into warfare an element which cannot be met entirely by instruments which operate in only two dimensions. As an instrument of peace, this most revolutionary contribution of American inventive genius is fast increasing in utility. In warfare, for evil or good, an instrument has arisen whose potency cannot be ignored, whose possibilities as an engine of destruction cannot be exaggerated, and to whose development every ounce of American energy should be devoted.

With the exception of very few patents exhibited, all disclose inventions which have originated new arts or affected profoundly our economic or social structure. These few exceptions relate to improvements which have given trend to the development of the basic invention, or are typical of early progress in the field, or are illustrations of many labor-saving substitutions in industry. The telephone transmitter, the electric heater and the iron and steel patents are illustrative of these several instances.

There can be no question of the overwhelming relative importance of the part taken by American inventors in transforming this old world of ours.

A mere perusal of the listed patents is sufficient to create that impression. No study of this impressive display can help but establish that invention as covered by the protection of the patent system is the basis of our industrial life, and that the whole superstructure of our economic well-being rests thereon.

Since the establishment of the patent system, every notable invention has been protected by the grant of a patent by one of the industrial nations.



THE IMPRESSIVE DISPLAY IN THE ROTUNDA OF THE UNITED STATES PATENT OFFICE

Printed copies of patents granted for contributions of fundamental importance and of primary character. In the left-hand illustration, Assistant Commissioner Dr. Kinans is shown at the left of the display and Commissioner of Patents Thomas W. Robertson is at the right

Radio at the North Pole

MacMillan Expedition to Test Effect of Aurora Borealis on Short Wavelengths

By Orrin E. Dunlap, Jr.

Copyright, Underwood & Underwood

Captain MacMillan and his Eskimo pup, "Kudlah"

LATE this summer Donald B. MacMillan's ninth arctic expedition expects to disclose by radio many secrets of the far north, which have long been concealed and protected from civilization by ice and cold weather. The explorers hope to ascertain whether or not there is an area of land over a million square miles between Alaska and the North Pole, and they will release the news of their findings via the ether. Robert E. Peary in 1906 saw what he believed to be the horizons of this unexplored arctic region, and MacMillan in 1914 observed the same headlands, but they vanished like a mirage.

The broadcasting equipment will be tuned to the 20-meter wavelength, because experiments have shown that the 20-meter signals at high noon are inaudible under 500 miles, but at greater distances they are much stronger than those radiated at night on higher wavelengths. The expedition during August and September will be in daylight twenty-four hours of the day, after passing 60 degrees north latitude.

MacMillan plans to anchor his ships, the *Bowdoin* and *Peary*, at Etah, Greenland, where the base will be established. Those who can read the Continental Morse code will understand the short wave impulses sent out by John L. Reinartz, low-wave expert of the expedition, as he flashes daily bulletins from the Northland. It is hoped that voices will also be sent into space just as they are from the broadcasting stations, and, if arrangements can be made, according to E. F. McDonald in charge of radio on the trip, the folksongs of the Eskimos will be sung.

There are eighteen thousand amateur operators in this country and many of them have built short-wave receivers to tune in the signals from the polar regions. MacMillan will stop at Godthaab to examine traces of 124 farms and the foundations of a dozen temples, the remnants of a settlement believed to have been established there by Eric the Red. At Turnivak, he will inspect the ruins of a colony thought to have been founded by Lief Ericson. The story of what the explorers find in these ancient settlements will be radiated into space.

John L. Reinartz, MacMillan's operator, has done considerable experimenting with short waves at his home in Manchester, Connecticut. Before he left for the north he explained the phenomena encountered by him in reaching extremely low wavelengths. He pointed out that code work in the daytime has been accomplished on as low as ten meters and that he had experimented with parasitic frequencies wavelengths below the possibility of measurement by present-day instruments. These frequencies are so extremely high that they are actually approaching the speeds of molecular vibration.

The transmitters of the expedition have four wavelength ranges, the lowest being 20 meters, then 40, 60 and 180. It is planned that the 20-meter channel will be used during the period just preceding and following noon. The 40-meter wave will, in all probability, be employed during the hours surrounding midnight, which will be daylight in the arctic but darkness in the lower latitudes. Eighty meters is an emergency wave to cope with unanticipated conditions and the 180-meter channel will be used to demonstrate that the 180-meter wave will not function over a great distance, unless freak atmospheric conditions are encountered.

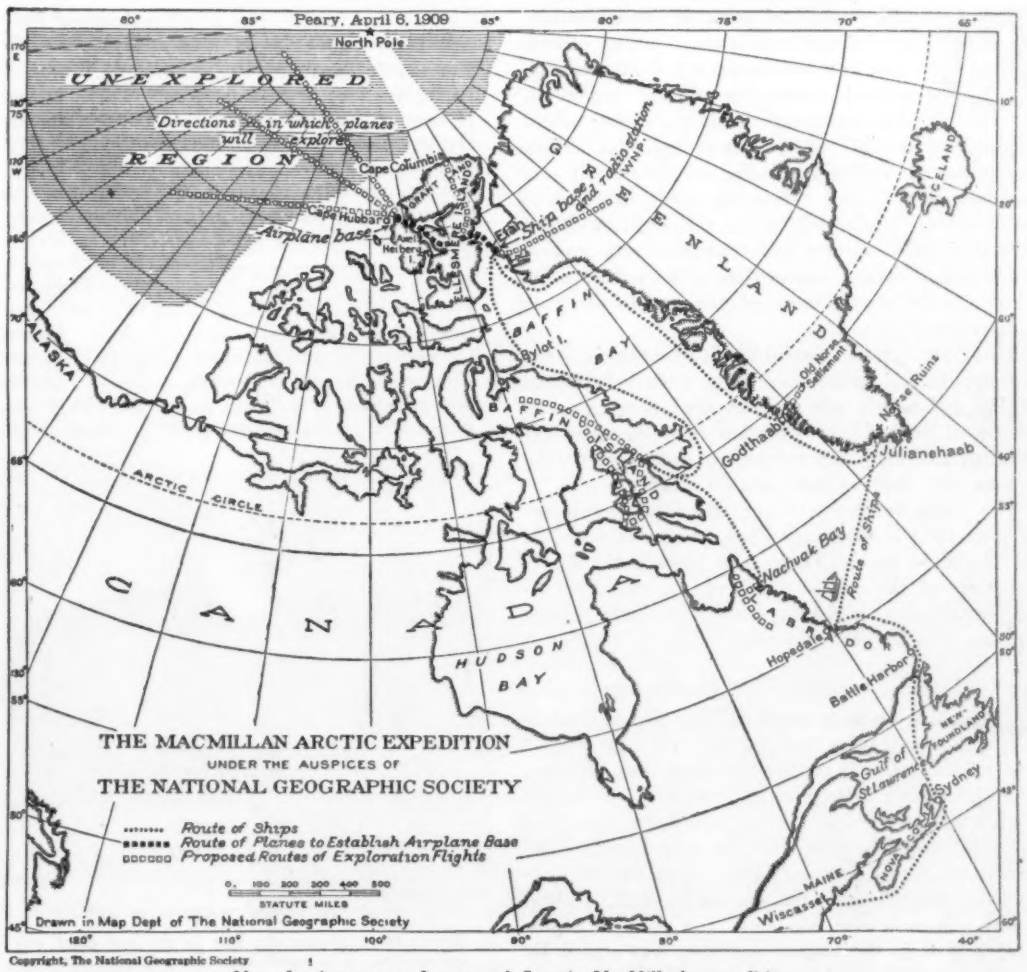
On the MacMillan trip in 1923-24, the 180-meter wave gave good results after the arctic night set in and there was no appreciable interference from the Aurora Borealis even when the ship passed through the Aurora belt, after which the Aurora display was in the south instead of the northern sky. Tests will be made to determine the effect of the Aurora on the short wavelengths. It may be found that low waves will not penetrate the Aurora band and if so the 180-meter set will be used.

MacMillan has found static bad in the arctic, especially during magnetic storms, when the disturbances were so violent that the magnetic needle traced like a scribbling pen across its record sheet on a revolving drum. It was also found that the northwest winds, carrying crystals of frost, created electrical impulses in the air, causing a roar in the phones.

The explorers expect to pick up entertainment from the broadcasting stations, chiefly, those in the mid-west and far west, because the expedition of 1923-24 did not hear any of the broadcasters in the Eastern section of the United States after they passed the coast of Newfoundland.

After a series of tests conducted at the naval air station at Anacostia, D. C., it was decided that the navy planes accompanying the expedition will carry different radio sets to cover all possible contingencies that may arise. One plane is equipped with the standard navy aircraft spark set. The other has a short-wave transmitter operating between 20 and 60 meters.

The navy set is considered superior for communication between the plane and the base ship while the plane is aloft. The short-wave set will probably be able to communicate with the base ship or the outside world in case of a forced landing. The operation of the navy set depends upon a wind-driven generator, which is effective only when the plane is in the air. The short-wave set was found to be ineffective when the plane was in flight, because of interference from the ignition system. The low-wave set which depends upon batteries will be of greatest use when the plane is on the water or on land and when the engine is dead. Each transmitter weighs about 100 pounds.



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Map showing proposed routes of Captain MacMillan's expedition

BOMBING THE U. S. S. NEW JERSEY FROM THE AIR

How Explosive Are Explosives?

Special Technicians Test the Sensitiveness, Stability, Power and Rate of Explosion of the Many Kinds of Explosives by Scientific Methods

By G. A. Rankin

Chemist, Chemical Warfare Service

SOME explosives, such as nitroglycerine, are single substances; while others, such as black powder, are mixtures of several substances. Some explosives are extremely sensitive, while others require a powerful blow to cause explosion. High explosives are violent, exploding at the rate of several miles per second. These are used when a shattering effect is desired, as in the artillery high-explosive shell. Others burn comparatively slowly, producing a pushing rather than a shattering effect. These are the propellants and are used to fire projectiles from guns.

There are various special kinds of explosives for use in mining operations. The so-called "safety explosives" which are used in coal mines are so composed that they give off but little flame on exploding, and thus they reduce the danger of setting fire to coal dust or inflammable gases.

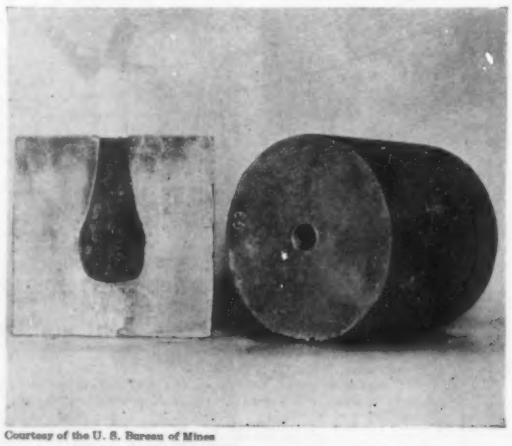
The particular purpose for which any explosive may be used is determined by a series of more or less standard tests. These tests include the determination of the sensitiveness of the explosive to mechanical shock and heat; also the stability, power and the velocity of explosion.

Falling Weights Test Explosives

The method usually employed for the determination of the sensitiveness of an explosive is to subject a small amount of it confined between steel surfaces, to a direct blow from a falling weight. The height from which the weight falls is varied until that just sufficient to cause explosion is determined. The sensitiveness of a number of the more common explosives, determined in this manner by Will, is given below. In each case one-tenth of a gram of explosive, placed in the impact machine, was struck by a falling weight of about four pounds:

Explosive	Height of Fall (approximate)
Mercury fulminate	3/4 inch
Nitroglycerine, dry	1 5/8 inches
Dynamite, Number 1	2 3/4 inches
Dynamite, Number 1, frozen	9 1/8 inches
Blasting gelatin	4 3/4 inches
Gelatin dynamite	6 5/8 inches
Gunpowder, sporting	28 inches
Gunpowder, blasting	30 inches
Tetryl	16 to 26 inches
T.N.T.	23 to 71 inches
Picric acid	13 to 30 inches
Guncotton, dry	4 inches
Guncotton, 15 percent water	14 to 37 inches
Guncotton, 20 percent water	74 inches
Nitrocellulose propellants	12 to 21 inches

Explosives somewhat less sensitive than mercury fulminate, such as nitroglycerine, can be employed in considerable quantities if proper precautions are exercised. Nitroglycerine is, however, too sensitive to be transported by common carriers. It is possible, however, to prepare explosives containing nitroglycerine which are much less sensitive than straight nitroglycerine. This is accomplished by mixing nitroglycerine with some suitable inert or less explosive material such as *kieselguhr*, or wood pulp and sodium nitrate.



Courtesy of the U. S. Bureau of Mines

THE COMMONEST TEST OF ALL

Before the explosion the hole in the lead block was cylindrical. The work done in enlarging the hole can easily be calculated

Temperature Affects Sensitiveness

Physical condition also has a marked influence on the sensitiveness of an explosive. For example, an explosive in the form of a fine powder is much more sensitive than it would be if this powder were compressed into a hard cake. Thus, powdered T.N.T. can readily be exploded with a mercury fulminate cap; whereas when fused into a hard cake, as in an artillery shell, it requires a much more powerful blow to cause it to explode. This is accomplished by a heavy, so-called "booster" charge of a somewhat more sensitive explosive than T.N.T., such as tetryl, which, encased in a tube, is imbedded in the T.N.T.

Temperature also has a marked effect upon sensitiveness. The higher the temperature, the more sensitive the explosive. This is illustrated by the data giving the sensitiveness of dynamite at normal temperature and when frozen, the frozen dynamite being much less sensitive. Thus, it is apparent that the sensitiveness of an explosive is a property that does not necessarily remain constant. If an explosive is too sensitive for a particular purpose, it is not a difficult matter to reduce the sensitiveness by the desired amount. In doing this, however, there is always the danger of destroying other desired properties.

An explosive is said to be stable if it does not undergo chemical decomposition or physical change under the conditions of storage to which it may be subjected. An unstable explosive may entirely lose its explosive properties due to chemical changes. Even so sensitive an explosive as mercury fulminate has been known to lose its ability to explode as a result of chemical decomposition. On the other hand, an explosive may become more sensitive or may even explode spontaneously as the result of chemical instability.

In addition to chemical stability one has also to consider physical stability. Thus, dynamites containing nitroglycerine, which is a liquid, may sweat or exude the nitroglycerine, bringing the sensitiveness of the explosive up to that of nitroglycerine.

Other explosives which contain substances such as ammonium nitrate, which readily take up moisture from the atmosphere, may be rendered absolutely unfit for use as explosives in a short time. Explosive mixtures made up of powdered materials which are not properly incorporated may become unstable when transported and jarred, due to the segregation of the various constituents. For that reason it is desirable that an explosive be a single chemical substance rather than a mixture.

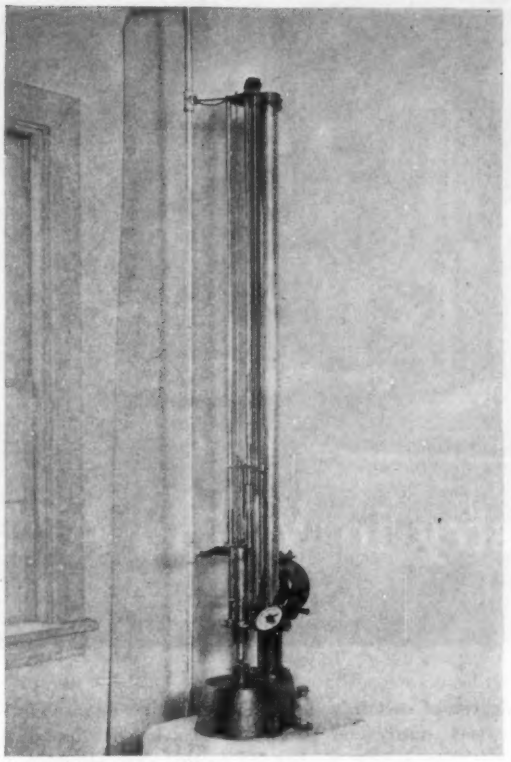
Rate of Detonation Can Be Determined

The power of an explosive is the amount of destruction or work which it will accomplish under suitable conditions. The work is accomplished by the sudden liberation of gas at a high temperature.

There is a great difference in the rates of explosion for different types of explosives; consequently there is a great difference in the nature of the work which they can perform. When ignited, slow explosives such as smokeless powder burn from the surface inward, and the velocity of burning never exceeds several yards per second. The work which is performed by this type of explosive is in the nature of a push and is employed for firing projectiles from guns. If, however, the high explosive, T.N.T., were substituted for smokeless powder to propel a projectile from a gun, the rapidity of the explosion would break the gun before the projectile had barely begun to move.

Another method of testing the power of explosives involves firing a charge in a steel bomb provided with gages for measuring the pressure generated. This also enables one to determine the total amount of heat of the explosion and the volume of gas.

Still another device is the ballistic pendulum.



Courtesy of the U. S. Bureau of Mines

HOW SENSITIVE?

The height from which the hammer of the impact machine falls to cause explosion determines the sensitiveness of the explosive

This consists of a heavy mortar suspended from an axis so that the amplitude of its swing can be measured. A charge of explosive is fired from a gun into the mortar and the extent of the swing imparted to the mortar is taken as a measure of power. This method is useful for comparing both low and high explosives.

The rate of detonation is one property of explosives which can be determined with considerable accuracy. There are two standard methods for this determination. One of these makes use of an electrical equipment connected by wires at two or more points in a string of cartridges containing an explosive. When the charge is fired, a recording instrument measures the time as the explosive wave travels from one wire in the explosive to the next wire. In the other method use is made of the fact that if a detonating fuse is laid on a lead plate and an explosion is started simultaneously from both ends, a sharp line will be left on the lead where the two explosive waves meet. It is thus possible by connecting known lengths of two explosives, contained in suitable cartridges, and firing them with suitably placed detonators, to determine the relative rates of explosion of the two explosives.

Neither is the rate of detonation ordinarily affected materially by the strength of the detonator or the blow used to initiate detonation. Nitroglycerine, however, is peculiar in this respect. If fired with a detonator of medium strength, the rate of detonation is about a mile and one-half per second; while, if a powerful detonator is used, the rate is increased to over four miles per second.

A term used in connection with high explosives which implies both power and rate of detonation is "brisance." Thus an explosive which combines great power with a high rate of detonation is said to be very brisant. A measure of brisance may be obtained by multiplying the power, as determined by the lead block test, by the velocity of detonation. It may also be determined by detonating cartridges of explosives on copper cylinders.

Explosives Tested in Miniature Mines

There are many other tests which involve the determination of the fitness of an explosive for a particular purpose. The United States Bureau of Mines has developed special tests for the permissible explosives, that is, for those which may be used in coal mining operations in the United States. For these tests a special gallery is provided. It is made of boiler iron, and is 100 feet long by six feet, six inches in diameter, and is closed at one end with concrete. Shelves are provided in this gallery for holding finely powdered coal dust such as would be found in a mine. A certain percentage of natural gas is also admitted to this gallery in order further to simulate mine conditions.

In order to be placed on the list of permissible explosives, ten shots of a weight equivalent to one-half pound of the standard forty-percent dynamite fired into eight percent of gas must cause no explosion; ten shots of the same weight fired into four percent of gas with the addition of twenty pounds of coal dust must cause no explosion; and ten shots of the same weight fired into forty pounds of coal dust must cause no explosion.

Thus, it will be seen that there are certain standard tests to which explosives are subjected, such as sensitiveness, stability, brisance and velocity.

Courtesy of the U. S. Bureau of Mines

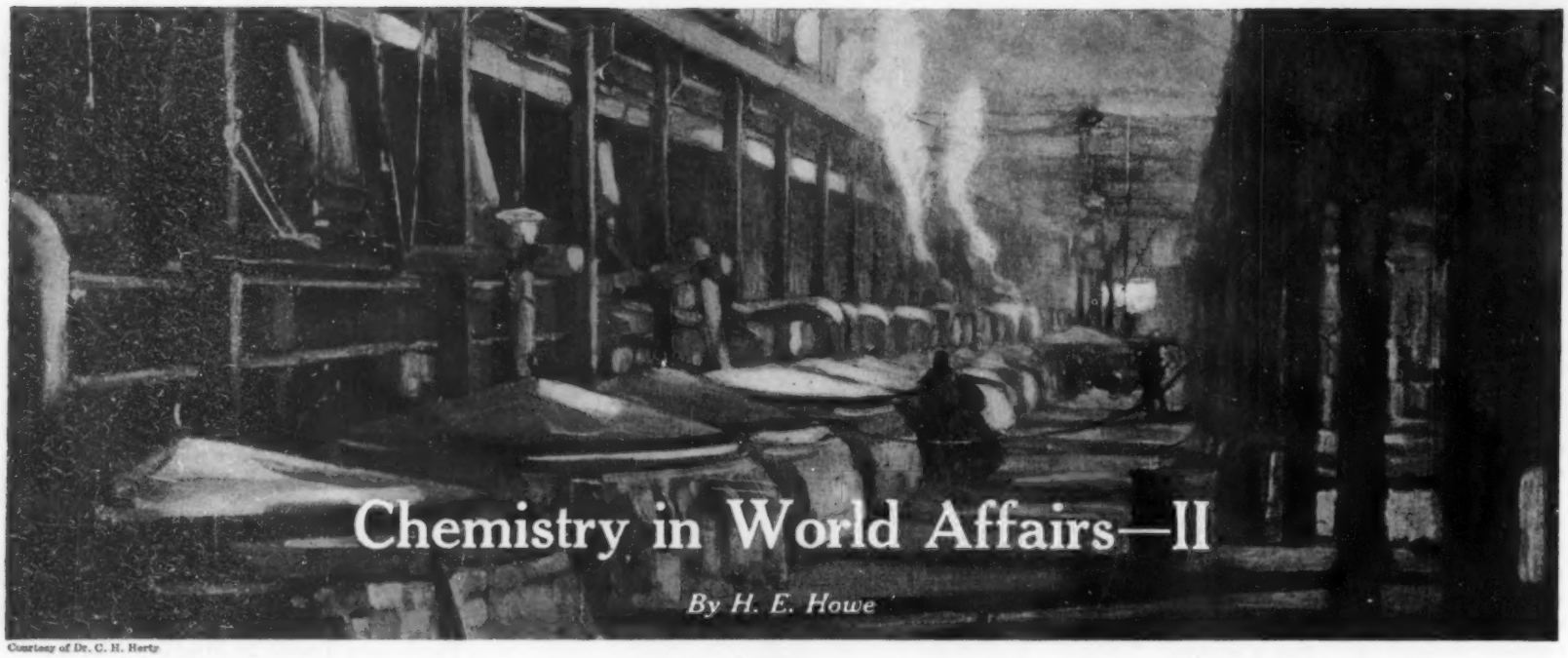
DOWN ANOTHER GUN'S THROAT

The amount of swing of the ballistic pendulum when one gun is shot at another gun measures the explosive's power

Courtesy of the U. S. Bureau of Mines

TESTING "SAFETY" EXPLOSIVES

Coal dust and inflammable gas in the artificial mine must not ignite when safety explosives are fired in it



Chemistry in World Affairs—II

By H. E. Howe

Courtesy of Dr. C. H. Herty

AN ADVANTAGE in world position has many times been lost because of the diligence of another nation in chemical research. We are indebted to necessities growing out of the Napoleonic wars for at least two important chemical developments. One of these is the production of sugar from beets. At a time when France was thoroughly blockaded and importation became next to an impossibility, the only source of sugar known was the cane of the tropical countries. The beets available did not contain more than five or six percent of sugar and this was accompanied by so many foreign materials as greatly to reduce its purity. No doubt the first sugar from beets was far from satisfactory, but it was very much better than no sugar. The English sugar traders became alarmed and offered the French scientists sums large for those days to suspend their research, but all propositions were refused.

Wars Stimulate Research

From that time the beet sugar industry has been developed not only in Europe but in the United States and constitutes one of the best examples of what can be achieved through scientific selection. Today whole crops of beets run well above 14 percent of sugar with a purity that is quite satisfactory. Concurrently the scientific methods for the extraction of the sugar from the beet, the purification of the sugar, the use of the waste beet pulp, and the utilization of other waste products has gone forward. Whereas it once required beets from one acre to produce 300 pounds of commercial sugar, we now obtain 3,600 pounds from the same area. Before the World War the production of beet sugar in the world had come to exceed that of cane sugar by several percent, and from an importer of sugar France had become an exporter. A few years ago France exported as much as 250,000 tons annually.

Another invention resulting from the Napoleonic wars was LeBlanc soda. Previously the important source of sodium carbonate was the native sesquicarbonate of Egypt, Africa, and South America. The normal carbonate or soda ash is prepared from this natural compound by continued boiling. Soda ash or the normal sodium carbonate is one of the most important basic heavy chemicals. It is used in many industries and processes and any nation must be assured a satisfactory supply. Since the blockade prevented France from importing with any degree of certainty, LeBlanc was called upon to find a way out. The process which he developed is operating almost unchanged to this day, although it could not have persisted but for the market developed for hydrochloric acid, an important by-product of the process.

The LeBlanc process begins with common salt and another heavy chemical, sulphuric acid. The process consists essentially of three parts. The first, which is the conversion of sodium chloride into sodium sulphate by the action of sulphuric acid, really involves two chemical reactions, both of which produce hydrochloric acid as a by-product. The next step is the decomposition of the sodium sulphate or salt cake by means of calcium carbonate or limestone and coal at a high temperature, whereby a crude mixture of sodium carbonate and calcium sulphide known as "black ash" is obtained. The extraction of this and the purification of the sodium carbonate it contains constitute the third and last step in the process.

This process has since been displaced to a large extent by the Solvay or ammonia soda process, which is based upon the fact that the bicarbonate of ammonia is decomposed by a strong solution of sodium chloride or salt. In practice, salt brine is first saturated with ammonia gas. The cooled ammonium chloride liquid is then charged with carbon dioxide under moderate pressure in carbonating towers.

THE BEGINNING OF SUGAR
Negro women gathering the cane in Cuba

From the solution the bicarbonate of soda separates out, leaving the more soluble ammonium chloride in solution from which the ammonia is recovered. The bicarbonate of soda is calcined and converted into the normal sodium carbonate or soda ash.

The siege of Paris gave us oleomargarine, which no doubt was a poor substitute for butter at the time, though none the less welcome. Since then margarine has become an important item of commerce. Dairy countries such as Holland and Denmark and agricultural states like those of our middle west consume margarine in quantity. With the introduction of nutritious coconut oil into occidental diets, margarine is now made of wholesome vegetable oils, churned in milk in plants which are models of cleanliness. The one point of weakness in the opinion of dietitians has been the absence of that unidentified, unisolated accessory food substance called fat-soluble vitamin A. This objection is largely overcome in the case of the highest grade margarines by the admixture of butter which also imparts color.

Importance of Supporting a Nation's Scientists

From the research now in progress we may expect the perfection of methods for preparing concentrated vitamins on a commercial scale which will make it possible to add them to otherwise satisfactory foods. This type of research is of utmost importance, not simply because of its relation to this one type of food but to others which, thanks to chemistry, can be prepared from staple raw materials.

As a result of research, milk can be dried without affecting its physiological characteristics. This dry milk is soluble and may be stored for months. If the fat is first removed, the dry skim milk will keep indefinitely in tins. Neutral refined coconut fat can also be kept without developing rancidity for a long time. Since these two basic materials can be made into milk or cream, with practically any desired percentage of fat, where and when needed, they offer great advantages in transportation and storage, with a guarantee of cleanliness and quality difficult to obtain in many quarters of the earth, particularly in the tropics. This type of food is wholesome and nutritious and satisfactory for adults. When chemical and biological research make it possible to add the fat-soluble vitamin, a food in every way equal to ordinary milk will be made available.

Nations also lose a world advantage when their

scientists are compelled to go elsewhere for support in developing their discoveries to the commercial production stage. It was due to such causes that Germany had the opportunity to develop the dyestuff industry and that the great Brunner-Mond establishment grew up in England. An effort to ruin England's West Indian trade by granting sugar bounties in France, Belgium, Germany and Russia forced England into industries using the cheap sugar of the continent. Sugar-containing foods remained an item of English trade even after she again took up refining following the abolishment of the bounties in 1899.

America Breaks Sicily's Corner in Sulphur

Japan has for years enjoyed a monopoly of camphor which has been a distinct advantage to that country. Camphor is used extensively in the arts, notably for the production of celluloid, motion picture films and the like, and in international relations cannot be ignored. This advantage to Japan has been partly lost of late through the demonstration that camphor trees can be grown in other countries, through the remarkable synthesis of camphor in the laboratory, and through research which has been successful in producing certain substitutes for camphor. It is said that for some industrial purposes none of these materials give quite the same result as the native camphor; but there is no reason to doubt that the cause for any difference will be found and the need completely met.

Like soda ash, sulphur is basic in the chemical industry, particularly in those phases essential for the sinews of war. Sulphur is the raw material for making sulphuric acid. The prosperity of a nation in peace and its strength in war can be almost measured by its production and consumption of sulphuric acid, and it has even been said that the civilization of a country can be so estimated. Formerly, sulphur-bearing ores were brought in quantity to this country, partly because of the value of the ore, but largely for the sulphur content. In other parts of the country research has shown how sulphur fumes from the ore roaster can be turned into sulphuric acid production.

The Sicilian corner on sulphur, managed by an English syndicate, has been entirely broken through the success of chemical engineering in America. Sulphur formerly came almost entirely from Sicily, where it occurred in concentration in various rock formations from which it was melted in crude kilns. This sulphur was seldom pure and was unsatisfactory for some uses. It was known that a thousand feet below the surface in Louisiana and Texas deposits of sulphur were to be found. Several attempts to reach them had only resulted in a loss of life and investment. Then came a chemical engineer who believed that he could successfully work within those narrow temperature limits where sulphur changes from an easy running liquid to a viscous sticky mass. His plan was to force superheated water and steam down to the deposit where the sulphur would melt and, under the pressure, flow to the surface.

When the experimental plant was ready and the first hot water turned into the pipes it was but a few moments until a stream of liquid sulphur more than 99 percent pure made its appearance at the surface. Presently the operation was stopped and it was weeks before it could be made to function again. However, it had been demonstrated that the plan was sound, and the engineer persisted. Today, America has the commanding position with respect to sulphur. Indeed, but for an arrangement with the English syndicate regarding price, the entire Sicilian industry would have been destroyed and the people left without a means for earning their livelihood. It is interesting to note that when the report of how pure sulphur was being pumped from the ground in America was first made to the English sulphur syndicate, the man who had the temerity to pass along such an exaggerated Yankee story was dismissed.

Canada enjoys a certain power through her great resources of nickel and asbestos. She has also relied upon her wood pulp, a product of chemical industry, to back her claims in international councils.

Efforts to Break Potash Monopoly

Few nations have been so favored as has Germany through the control of the natural resources made valuable by chemistry. This is particularly true of the great potash beds which, however, were not discovered until long after the deposits had been worked for ordinary salt. With the utilization of rock-salt deposits in various localities, a time came when the price of salt fell and the Stassfurt works ceased to yield their former large revenue to the Prussian Government. With a view to making them more valuable, it was decided to sink the shaft further in the hope that rock salt might be discovered.

At a depth of 1,300 feet a stratum of rock salt was found, but in reaching it the shaft passed through a heavy deposit of refuse salts which were considered worthless. Chemical analysis showed these salts to consist largely of magnesium-potassium chloride, potassium chloride alone, and a mixture of these compounds. The Dutch scholar Van't Hoff demonstrated that these materials could be separated by crystallization, and today these refuse salts are the world's chief source of supply of potashes and potassium salts.

An effort is being made in the United States as a result of war activity to break this potash monopoly. While a part of the deposit is no longer German property, the deposit as a whole is very important in international affairs and might at any time give those nations controlling it a commanding position. The natural lakes of Nebraska, the alunite ores of Utah, and the greensands of New Jersey are sources of potash but at present prices cannot compete with the low mining and purification costs abroad. The fact that the greensands of New Jersey yield as a by-product the material for sand lime brick in an area where construction creates a demand for this building material may well prove a saving factor in that instance.

The greatest deposits now being worked in America are those at Searles Lake, California, where research similar to that conducted by Van't Hoff on German deposits but of a different and higher order of complexity, has shown that the mixed deposit of that lake can be commercially separated. Potash of high purity is being produced, with quantities of borax among the by-products. We are also told that Texas may at any time be able to announce extensive potash deposits. Italy is supporting research in the hope of recovering great quantities of potash from her mineral leucite.

New Explosives Change World Relations

The changes in world relations due to new explosives will be obvious. Many world policies were changed with the completion of the Panama Canal, which would have been impossible but for the work of medicine and sanitation combined with chemical explosives. Our most recent example, TNT, was responsible for the rapid reduction of those Belgian cities which were protected with concrete fortifications. Concrete, itself made by a chemical process, might not have been so easily crumbled but for the research on toluol.

Toluol is used as a basic material in certain types of dyes. When it is nitrated, two mono-nitro-toluols are formed simultaneously. One of these mono-nitro-toluols was desired for dyes; for the other there was no known use. Research was therefore undertaken with two objects in view; first, to produce a larger proportion of the mono-nitro-toluol which was wanted for dyes, and second, to discover a use for the other variety. Little progress was made, and suddenly the problem disappeared from the scientific literature.

After Liege it became known that upon further nitration it had been found that tri-nitro-toluol could be formed from that mono-nitro variety undesirable for dye uses. Consequently efforts were bent toward increasing rather than decreasing the toluol which could be transformed into this high explosive.

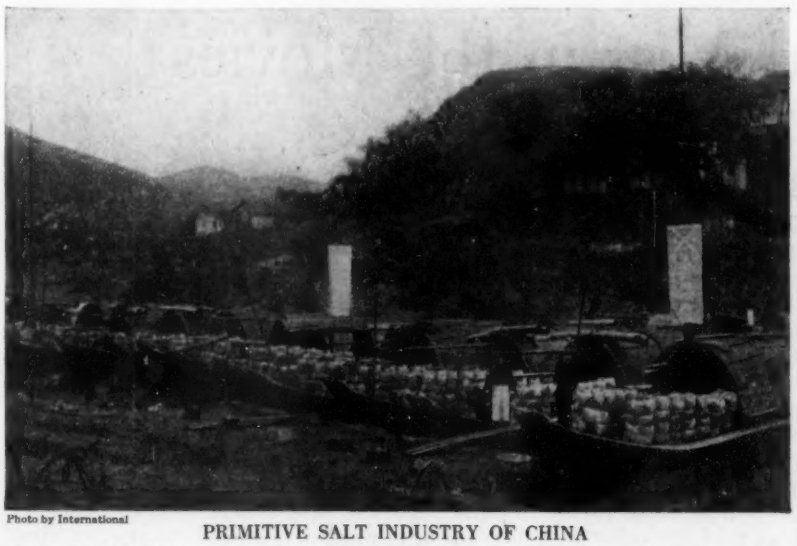
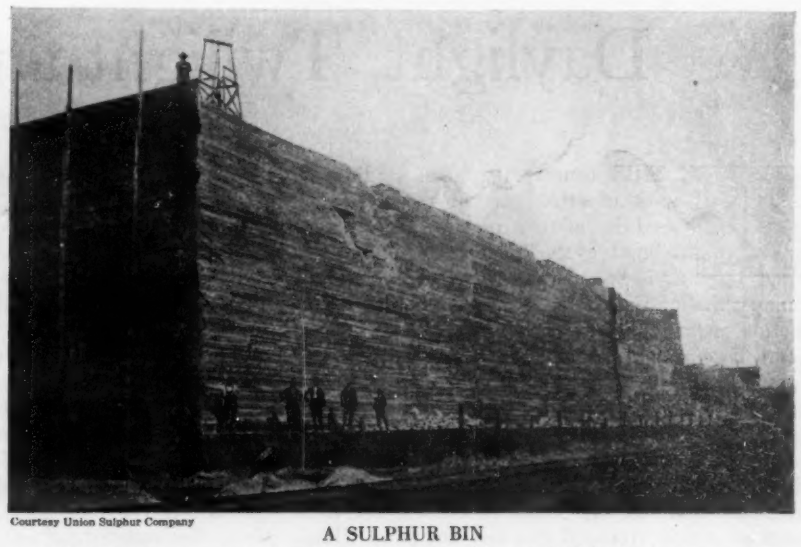


Photo by International

PRIMITIVE SALT INDUSTRY OF CHINA

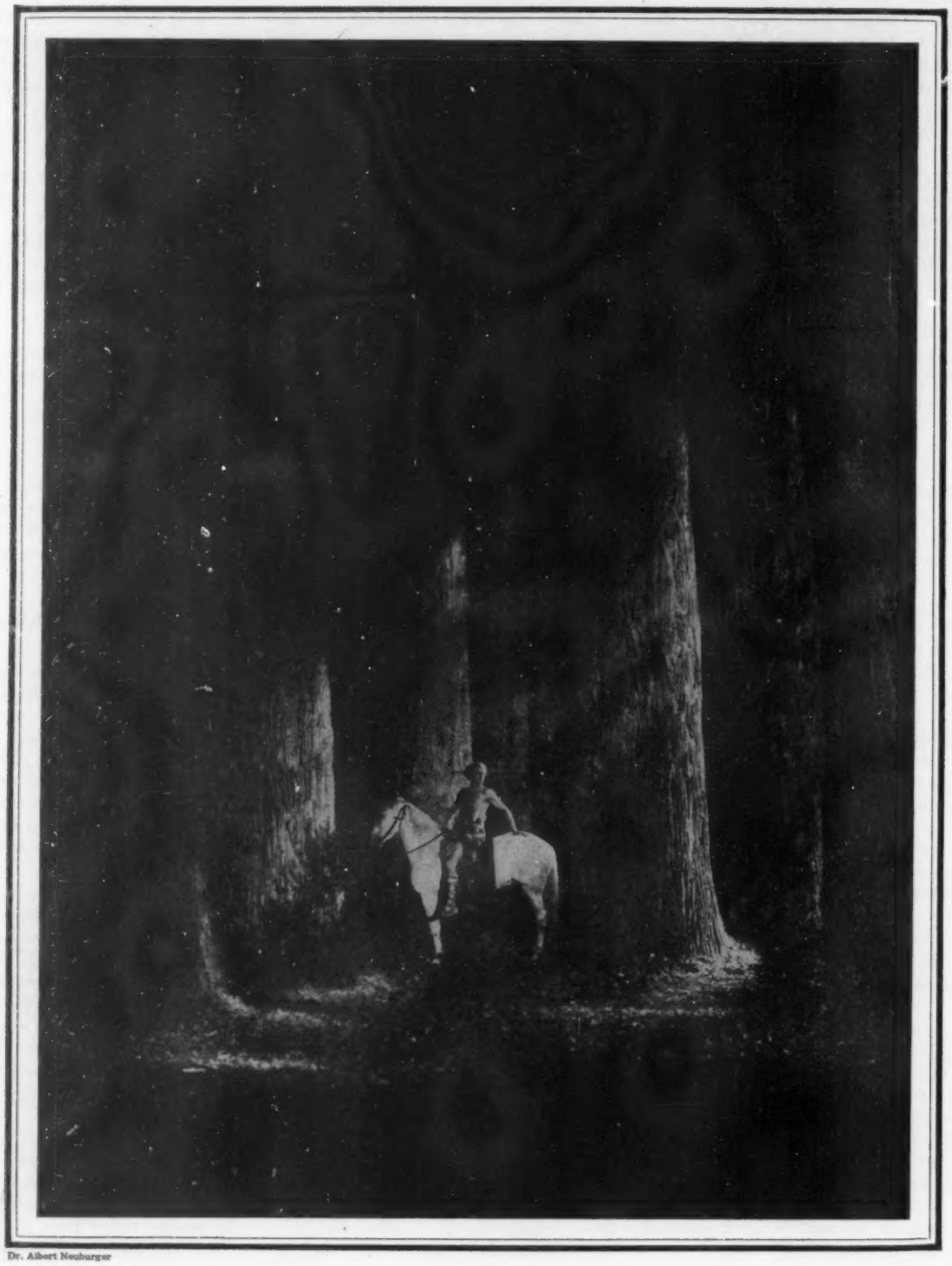
Bags of salt loaded on native boats and carried to the coast or wherever the salt is needed



Courtesy Union Sulphur Company

A SULPHUR BIN

This looks like a lumber pile but in reality it is sulphur marked by the lumber frames



Dr. Albert Neuburger

Daylight, Twilight and Mist in the Movies

By Edward Ellington

IN THIS country the glass studio is a most effective part of the equipment used in motion picture photography. Almost every "movie fan" knows that it is because of the warm climate and sunny skies of California that a large part of the motion picture industry of the country has in recent years become concentrated in Hollywood; and the long, warm days and strong light of California, together with the glass studio, form an ideal combination for the production of artistic motion picture films. By means of the glass studio, daylight is so diffused that shadows are eliminated and there is an even illumination. In order to control the light, curtains are so arranged that any degree of illumination may be obtained.

When daylight fails him, the producer merely switches on as many lights as he sees fit. In fact, in the average studio, electric lamps are employed the greater part of the time because of the ease with which they can be arranged and controlled so as to produce those wonderful lighting effects which play such an important part in the best films of the day.

We rather pride ourselves on this phase of our moving picture production, and justly so; but occasionally something comes from abroad which shows us that we have not a monopoly of artistic lighting effects. Some of the recent developments in Germany are noteworthy. On these pages we present two photographs which have come to us from that country and which we think are rather remarkable in their effective lighting.

The Germans have an enormous fund of material which may be used in the production of motion picture films in the great epic the "Nibelungenlied." We in this country are familiar, of course, with Wagner's massive cycle, "The Ring of the Nibelung"; and we know that an effective production of the opera calls for a truly stupendous combination of music, dramatic action and advanced stagecraft.

It is for the purpose of producing motion picture films of the Wagnerian-opera type and of giving such themes the proper background, and the necessary accessory lighting equipment that a German firm of motion picture producers, the Decla-Bioscop Company, has had built a huge "daylight hall," as they call it, in which it is possible to produce films which require special lighting effects. One of these

films, for example, recently produced by this firm, was "Kriemhild's Revenge." In this "daylight hall" it is possible to produce the delicate shades of twilight and the blackness of night, the soft, mystic light pouring through the rose window of a great Cathedral and the last rays of twilight slanting through the forest.

The "daylight hall" is very large, and has no roof. Mountains and woods have been built into the hall, and a gallery runs around the side and back of the building. In the gallery are stationed various spot and flood lights. By means of these lights it is possible to take photographs during the twilight hours and to bring certain groups into prominence by lighting them effectively. Just as in night scenes with which we are familiar, where darkness and the sharp lights of street lanterns, or of shop-windows or of the lamps of a motor car are photographed effectively, in this hall the soft shades of twilight are filmed, and the slow, gradual and harmoniously changing shadows of approaching night are shown.

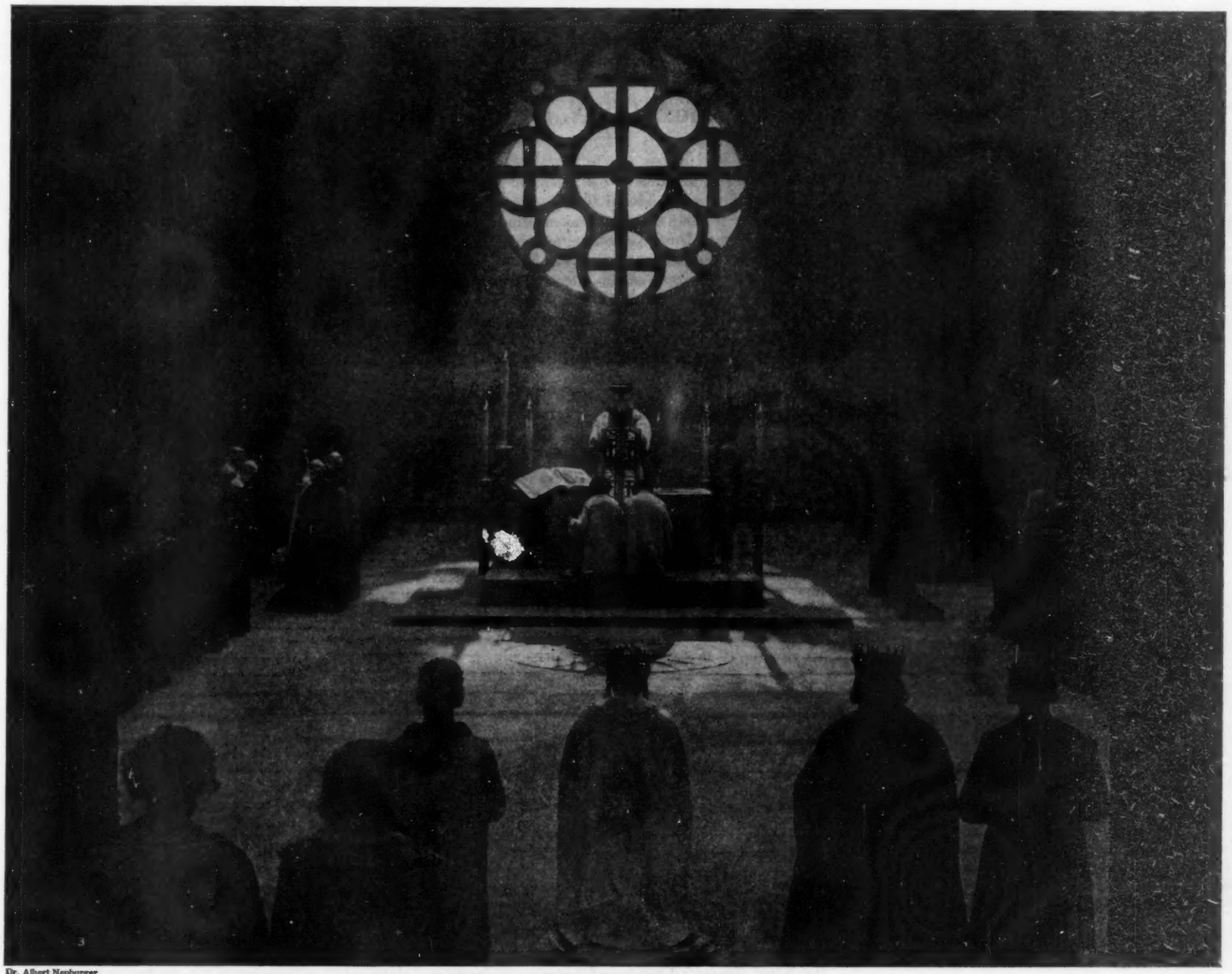
Certainly the producer of some of our modern moving picture films has some pretty difficult problems to work out, and his is an art which requires not only ingenuity but certain technical knowledge as well. Imagine, for example, a film representing a horseback rider speeding across the Scottish moor while mists are rising to envelop him and his horse. While it might not be difficult to reproduce an effect resembling fog, the difficulty would come in the attempt to effect a mist thick enough to completely hide the bodies of horse and rider, but which would leave the head and shoulders of the rider sufficiently visible to be photographed. Imagine, too, that this rider is on his way to a castle which finally appears on the horizon shimmering in the northern lights.

Anyone who has ever had the breath-taking joy of witnessing the northern lights could not but wonder how a mere photographer could anywhere nearly approximate the almost uncanny electric glow, the first coming of the pale lights, quivering and filling the wide spaces of the sky with uncertain shimmer.

But the prosaic photographer has found a way to produce the effect of these natural phenomena to a degree, at least. The mist keeping to the ground, for example, is produced by the use of vapors which condense to mists in ordinary temperature; and the condensation is quickened by some artificial assistance, such as powerful refrigeration.

For the production of imitation northern lights, dozens of giant searchlights, each operated by several men, are stationed in the galleries of the roofless hall. The searchlights are directed in such a manner that their rays are directed back and forth over the background of the scenery. Each of them is set upon a stand, which may be made to tremble and shake slightly. They are moved without interruption in a certain rhythm, turned on, or off, and kept in a trembling movement constantly, the while a violet light plays over the flickering, shimmering ensemble. In this way is the illusion of the magnificent northern lights produced.

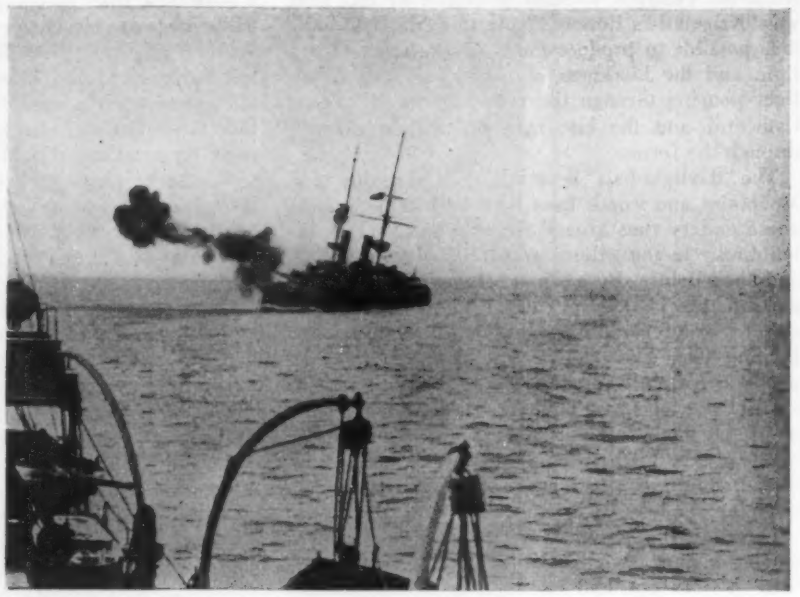
As a matter of fact, the scenic effects called for in the successful production of Wagnerian opera are perhaps more easily obtained by modern motion picture equipment than by the most advanced methods of modern stagecraft; and most of us know how crude and almost ridiculous some of the most sublime moments of Wagnerian opera may become without the proper scenic accompaniment. For example, imagine the passing of the gods into Valhalla over the rainbow bridge when the rainbow bridge is obviously, as it so often is with small operatic companies touring the country, of crude construction. The great operas, "Siegfried," "Die Walküre," "Götterdammerung," all offer an almost untapped source of material for beautiful and educational moving picture films.



Dr. Albert Neuburger

FILMING A CATHEDRAL SCENE IN THE OPEN AIR

A remarkable example of German photography showing mystic dawn in the cathedral. Note how the lighted candles shine clearly against the light of early dawn streaming through the windows



TWO SHIPS OF GREAT BRITAIN'S FLEET

LEFT: *British battleship* Royal Oak *showing "bulge" or "blister" protection (1924 Photograph Cribb) reproduced from "Jane's Fighting Ships 1924 (Sampson, Low, Marston & Company, Ltd., London).* RIGHT: *British battleship* Revenge *in action against German forts on the Belgian coast in 1915. (The ship is equipped with bulges or blisters and, in order to give greater range to her guns, is shown heeled over by emptying the bulge on one side while the opposite bulge is left full of oil or water.) (From "The Dover Patrol 1915-1917" by Admiral Sir Reginald Bacon—George H. Doran Company)*

Another Side of the 5-5-3 Argument

An Article by Captain Dudley W. Knox, U.S.N. (Ret.) Reproduced as It Comes to Us

PURSUING our policy of giving both sides of a controversy of general interest, we publish herewith the arguments of one of the chief proponents of the theory that our battleship fleet is considerably below the strength allowed by the 5-5-3 treaty. In a subsequent issue Mr. J. Bernard Walker, our naval expert, will answer the various points in detail. Captain Knox's letter and article follow.—*Editor.*

Washington, D. C., April 29, 1925.
Editor, Scientific American,
233 Broadway,
New York, N. Y.

Dear Sir:

I note an article in the current issue of your paper by Mr. J. Bernard Walker entitled "Last Word on the 5-5-3 Ratio." It is my opinion that the article seriously misrepresents the question of the relative strength between the battleship fleets of the United States and Great Britain. There are important omissions of fact and some of the facts stated appear to be incorrectly interpreted.

The general effect created by the article is that the modernization of certain of our older battleships recently authorized by Congressional action is not necessary. Mr. Walker advocates no reduction in the appropriation asked for for "repair work" but the modernization authorized is so comprehensive as to be beyond the scope of repair work. To fail to complete the authorized modernization would in my opinion, result in a serious impairment of the sea power of this country regardless of any comparison with the British fleet, since other fleets are to be considered also. I therefore deem the article harmful to the maritime interests of this country and suggest that you give me the opportunity of replying to it in the next issue of your paper.

Very sincerely,
DUDLEY W. KNOX,
Captain, U. S. N. (Ret.)

That the American battleship fleet is substantially stronger than the British battleship fleet is the principal contention of an article by Mr. J. Bernard Walker in the May issue of the Scientific American. In conclusion, presumably on account of such alleged superiority, he limits his recommendation of what should be done to our battleships to "repair work."

It should be understood that the last Congress, following the recommendations of the Secretary of the Navy, and the President, authorized extensive "modernization" of six of our oldest battleships. Nine million dollars, one half of the total amount ultimately necessary, was appropriated for this specific purpose.

Alterations Will Increase Fighting Power

The modernization plan is much beyond the scope of anything which could be characterized as "repairs." It amounts to extensive alteration of design. The deck is to be armored as a protection against aerial bombs and the plunging effect of modern long range gunfire. The underwater hull is to be protected against damage from mines, torpedoes, and bombs, by fitting "bulges" or "blisters," which as their name indicates, are structures built on outside the old hull. They project ten feet or more beyond the original underwater side of the ship and extend longitudinally through most of her length.

Another large item of modernization is the conversion of boilers and bunkers so that oil fuel may be used instead of coal. This will increase not only the maximum distance which the vessel can steam, but also her dependability for sustained high speed —a very important feature in battle.

All of these large alterations of design are intended to increase the fighting power of the ships—to bring our fleet more nearly to a 5-5-3 ratio in battleship strength which it is now below. Naval officers and civilian officials recommended increasing the elevation limits of our battleship guns to give them greater range as an additional item of modernization necessary to the same end. The British government considered that this would be a violation of the Naval Treaty. French and Japanese authorities supported the American view as to treaty interpretation. President Coolidge maintained that we had a legal right to elevate the guns but settled the controversy by striking the gun elevation item out of the modernization program on the ground of national economy.

Mr. Walker has revived the gun elevation controversy after it had been settled for several months. There would be little need of my further perpetuating it herein, except that his argument to prove that we did not require greater gun elevations furnishes equally good reasons against the other items of modernization. If our fleet is already above the standing of five in the 5-5-3 ratio, if we already "have the whip hand," as he claims, there is little reason in our spending $18,000,000 for the purpose of attaining that ratio, in the face of a firmly held national policy of economy.

The three principal fallacies in Mr. Walker's exposition of the relative strength of the American and British battleship forces pertain to questions of (1) maximum firing range, (2) speed, and (3) tactics. In order to demonstrate these fallacies the more clearly I will refer to his own tabular statements, reproduced herein (tables on the following page) from his original article.

With regard to the question of maximum firing ranges eight of the British capital ships listed have the ability to shoot about 5,000 yards farther than stated in the table. No such correction can be applied to any of the American battleships. The discrepancy arises from the fact that the five ships of the *Royal Sovereign* class, together with the *Repulse, Renown,* and *Warspite,* are equipped with "bulges" or "blisters.' As explained above, these queer structures are for the primary purpose of protection against underwater damage from mines, torpedoes and bombs. But they offer an important additional advantage of permitting the ship to be easily heeled over a few degrees, by pumping the oil or water, which they normally contain, from the blister on one side while leaving the other side filled. The manifest effect of this upon guns pointed outboard is to increase the angle between their axis and the horizontal, and thus permit them to shoot farther.

CAPITAL SHIPS OF THE BRITISH NAVY

Name of Ship	Turret Guns: Diameter of Bore in Inches	Turret Guns: Length in Calibers	Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
Royal Sovereign	15	42	20	24,300	21.6	25,750
Royal Oak	15	42	20	24,300	21.5	25,750
Revenge	15	42	20	24,300	21.9	25,750
Resolution	15	42	20	24,300	21.6	25,750
Ramilies	15	42	20	24,300	21.5	25,750
Malaya	15	42	20	24,300	25.0	27,500
Valiant	15	42	20	24,300	25.0	27,500
Barham	15	42	20	24,300	25.0	27,500
Queen Elizabeth	15	42	20	24,300	25.0	27,500
Warspite	15	42	20	24,300	25.0	27,500
Hood	15	42	30	30,300	31.5	41,200
Renown	15	42	20	24,300	31.5	26,500
Repulse	15	42	20	24,300	31.0	26,500
Tiger	13.5	45	20	23,800	29.0	28,500
Benbow	13.5	45	20	23,800	21.5	25,000
Emperor of India	13.5	45	20	23,800	21.5	25,000
Iron Duke	13.5	45	20	23,800	21.6	25,000
Marlborough	13.5	45	20	23,800	21.6	25,000
Thunderer	13.5	45	20	23,800	21.	*22,500
King George	13.5	45	20	23,800	21.4	*23,000
Ajax	13.5	45	20	23,800	21.1	*23,000
Centurion	13.5	45	20	23,800	21.9	*23,000
Grand Total						580,450

*These four to be scrapped when *Nelson* and *Rodney* are completed, when total will be 558,950, against United States 525,850; the extra tonnage allowed to offset greater age of British Fleet.

Republished from our May issue

This is not an ideal way of gaining increased range, but it is much better than no way. The disadvantages are a temporary reduction in speed and impaired armor protection on account of lifting the lower edge of the armor belt close to or above the water-line. The latter disadvantage disappears when the enemy guns cannot reach. Special appliances for quickly flooding or emptying compartments, such as are commonly employed in submarines, may make it possible to promptly rectify the disadvantages whenever circumstances so demand. As early as 1915 the British used this general method of increasing the range of battleship guns while in action against German ports on the coast of Belgium.

In addition to the eight British ships named as being already able to shoot about 5,000 yards farther than shown in the table, we must count a similar increase for four more in the near future, since according to British handbooks the Admiralty intends to fit all ships of the *Queen Elizabeth* class with "bulges." This will make a total of twelve ships of 5,000 yards greater maximum range than stated.

But even this is not the whole story of British gun range in relation to the need of our modernization to prevent falling farther behind in the theoretical 5-5-3 ratio. The British are now building two battleships stronger than anything afloat. Each will carry nine 16-inch guns, which in all probability will outrange anything that we have. These new ships begun in 1922 should be completed next year and will replace the four old British battleships standing at the bottom of the list.

Oil-burning Ships Almost a Necessity

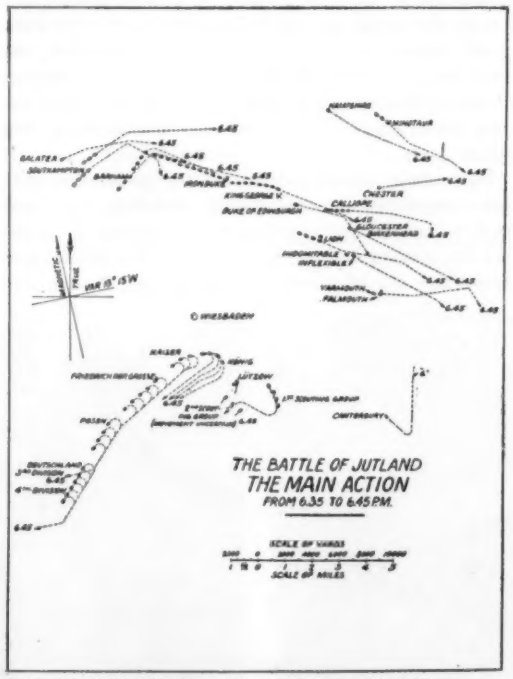
The average maximum range of their fleet after the above mentioned changes will be about 28,600 yards, as compared with 24,600 yards for our fleet at present. The addition of "blisters" to six of our ships should enable the American fleet to average about 26,000 yards, leaving the British an advantage of about 2,500 yards in fleet range. This gunnery aspect of the comparison is also greatly affected by the aggregate weight of the projectiles fired in each broadside, which gives an index of the damage to be expected from hits. These figures are British 315,000 pounds, and American 262,000 pounds.

Let us now pass to a consideration of speed, an element of great importance in getting guns to a position from which they can reach an enemy. From this viewpoint oil-burning ships have become almost a necessity. Large fleet battles last a long time and require much high-speed steaming. In coal-burning ships boiler grates, furnaces, and uptakes, become foul and firemen become tired, sometimes cutting down the maximum speed several knots. On the other hand, oil-burning ships can maintain their maximum paper speed without difficulty.

We now have six coal-burning battleships and the British four. All of these carry a small amount of oil for emergency use—the British ships twice as much as ours. But in about a year the British coal burners will be scrapped and replaced by the *Rodney* and *Nelson*, when their entire fleet will be on an oil-burning basis. Their slowest battleships already have a battle advantage of about one knot over ours, which will become greater when their new ships come out. Unless we modernize, this disparity will be greater and the difficulty of a large proportion of our ships getting into action will be increased.

This matter of speed also enters very vitally into the final question to be discussed—that of tactics. It will be noted that the entire American fleet closely approximates to twenty-one knots maximum speed, whereas nearly half of the British ships are capable of doing twenty-five knots. Four of their ships are rated around thirty knots—a very high speed for capital ships. This gives to the British fleet a great tactical advantage readily convertible into terms of range and gun-power.

Mr. Walker's conception of a fleet battle being fought in two parallel columns is more than 100 years out of date. For centuries such was the practice rigidly required by official fighting instructions. It took a Nelson to explode the old fallacies and to demonstrate the crushing effect of applying afloat the well-known land practice of concentrating superior forces against a part of the hostile formation. Since Nelson's day that has been the great cardinal object in naval tactics. By a successful concentration on the Russian flank at the battle of Tsushima



Redrawn from British "Official History of the War" (Longmans, Green & Company

DIAGRAM OF A FAMOUS BATTLE

The upper group of ships represents the British Grand Fleet and the lower group, the German High Seas Fleet. The time corresponds to the completion of Admiral Jellicoe's initial deployment to attain a position on the flank of the slower German fleet rather than fight a "parallel column" battle. Note the position of the British fast capital ships (headed by Inflexible and Lion) which have separated from their main fleet to reach the flanking position more quickly

CAPITAL SHIPS OF THE UNITED STATES

Name of Ship	Turret Guns: Diameter of Bore in Inches	Turret Guns: Length in Calibers	Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
West Virginia	16	45	30	34,500	21.2	32,600
Colorado	16	45	30	34,500	21.4	32,600
Maryland	16	45	30	34,500	21.1	32,600
California	14	50	30	35,500	21.7	32,300
Tennessee	14	50	30	35,700	21.4	32,300
Idaho	14	50	15	24,000	21.3	32,000
New Mexico	14	50	15	24,000	21.1	32,000
Mississippi	14	50	15	24,000	21.1	32,000
Arkansas	12	50	15	24,350	21.1	26,000
Wyoming	12	50	15	23,500	21.2	26,000
Arizona	14	45	15	21,000	21.0	31,400
Pennsylvania	14	45	15	21,000	21.1	31,400
Oklahoma	14	45	15	21,000	20.6	27,500
Nevada	14	45	15	21,000	20.5	27,500
New York	14	45	15	21,000	21.5	27,000
Texas	14	45	15	21,000	21.0	27,000
Florida	12	45	15	22,000	22.1	21,825
Utah	12	45	15	21,600	21.0	21,825
Grand Total						525,850

Republished from our May issue

the Japanese fleet quickly annihilated with small losses to themselves the theoretically stronger Russian fleet.

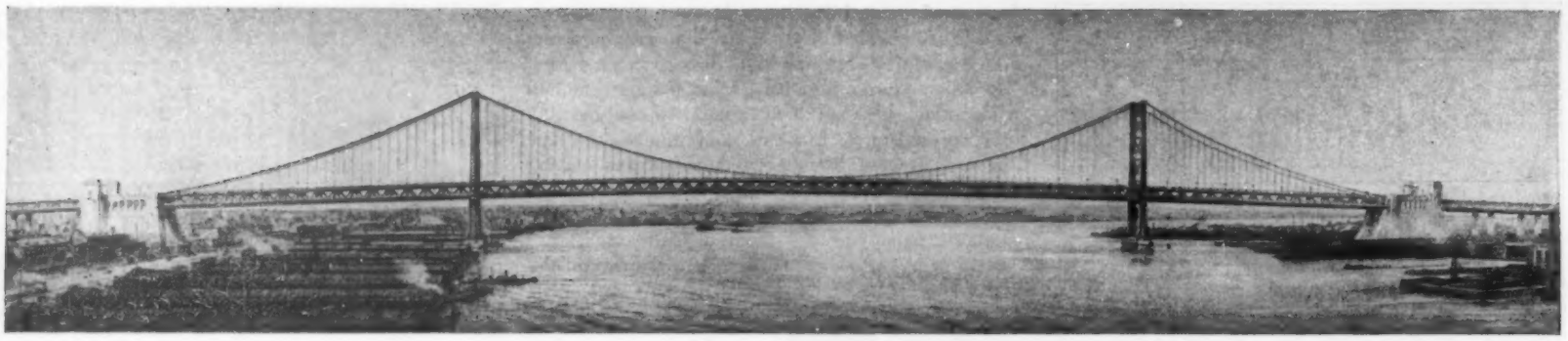
One can search the diagrams of the battle of Jutland in vain for any reasonable approximation to a parallel column position as between the two main fleets. From the beginning to the end of this long battle Admiral Jellicoe's principal tactical object was to get on the German flank, where all of his broadsides could bear on the few German ships which could reply from the end of their line. Jellicoe reached this advantageous position three times but failed to reap the advantage of it principally on account of the misty weather.

It is true that a slow fleet may seek to bring on a parallel fight—but only as a measure of self defense to prevent the fast fleet from reaching the coveted flank position. In the case under discussion the nine fast British ships have such a great superiority of speed that they should normally be able to gain the American flank in spite of anything the latter fleet can do. Naturally they would choose the particular flank nearest to the remaining eleven slower British ships. Thus, one American flank would be subjected to the concentrated fire of the entire British fleet, while the other flank would be out of range. Such a tactical concentration would inevitably mean an early sweeping and British victory.

Logic of Modernizing Apparent

To sum up. The approved modernization of the American fleet can serve only to reduce the existing superiority of the British fleet—a superiority which otherwise would be even greater when British modernization now in hand has been finished. With the modernization now in progress for both fleets completed the British will then have a superiority of about 2,500 yards in average range, twenty percent in weight of broadside fire, and a very marked tactical advantage incident to speed. The logic of modernizing our ships is apparent.

The writer is not one of those who believes that war is probable between this country and Great Britain. He does believe, however, in the principle of equality of naval power with our cousins, which principle was formally subscribed to at the Washington Conference. Such equality seems more likely to preserve peace between the two great leaders of the world than any substantial difference in sea strength, since equality means a greater mutual respect for each other's interests in the trade rivalries which seem certain to continue.



The Delaware River Bridge

Connecting Philadelphia and Camden by the World's Longest Suspension Bridge

By J. Bernard Walker

THE century-old idea of building a bridge across the Delaware River between Philadelphia and Camden is at last being realized, for in 1919 this greatly needed construction was initiated by the appointment of the Delaware River Bridge Joint Commission, which selected Ralph Modjeski as the Chairman of a Board of Engineers and Chief Engineer.

Not only will the new bridge, whose opening is set for July 4, 1926, include the longest span of any of the great suspension bridges, but it will possess novel features which will make it distinctive among them. The main towers, whose topmost point will be 385 feet above the water, are built entirely of massive, plate-steel box sections. They are of great simplicity in outline; taper very gradually down to the level of the floor of the bridge; and then sweep out in easy curves to meet the steel foundation plates upon which they rest. They are stiffened in the transverse direction also by box-section reinforcements on both sides of the legs, which taper in a similar manner and spread out to provide the necessary width of base for stability; also they assist in giving a pleasing architectural effect to the tower. The two legs are tied together with four heavy trussed transverse members, one above and one below the roadway, and one at the base and another at the summit of the tower. There are also three panels of heavy box-section trussing in the upper half of the tower and a single panel below the floor level.

The foundation of each tower consists of a large rectangular steel and wood caisson sunk to rock and filled in with concrete. Above the caissons, the foundations are carried up in concrete, with granite facing.

The steel towers are built of a special silicon steel, having an ultimate strength of 80,000 to 90,000 pounds per square inch, and a minimum yield point of 45,000 pounds per square inch. For the machining of the sections of the towers, it was necessary to build two large rotary planers—the largest ever constructed—each of which has a head 108 inches in diameter, with 108 cutting teeth. The erection of each tower was done by means of a special creeper-traveler, consisting of an A-frame, with braced stiff legs and a single 60-foot steel derrick boom. The traveler was supported on I-beams bolted to the bracing of the tower and was raised to six different positions in carrying the tower to its full height of 347 feet above the masonry.

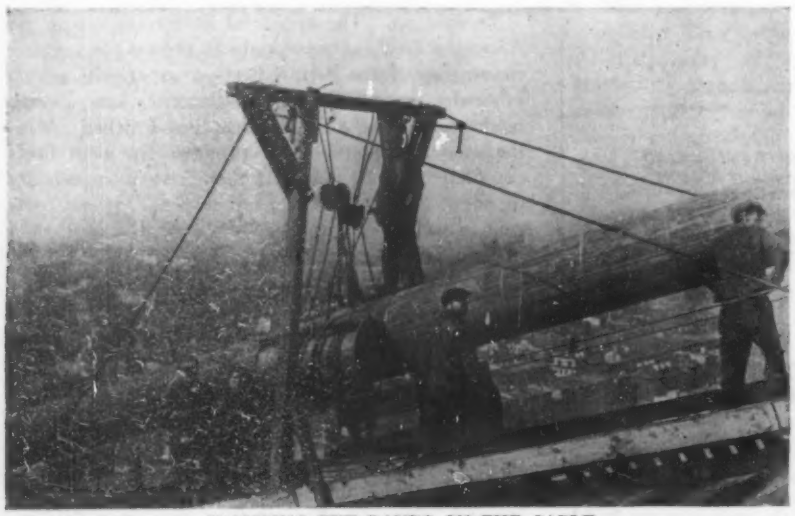
Design Marked by Great Simplicity

The total length of the bridge, from anchorage to anchorage, is 2,253 feet 4 inches, consisting of 1,750 feet in the main span and 751 feet 8 inches in each of the shore spans. Including the approaches, the total length of the bridge from Franklin Square, Philadelphia, to Penn and Sixth Streets, Camden, New Jersey, is 9,500 feet, or but little short of two miles.

The whole design is marked by great simplicity and concentration, and special attention has been paid to the architectural features, particularly in the two anchorages and the approaches. The anchorages themselves are of concrete, with granite facing, and upon them are carved the coats-of-arms of the two cities and the two States that are jointly building the bridge.

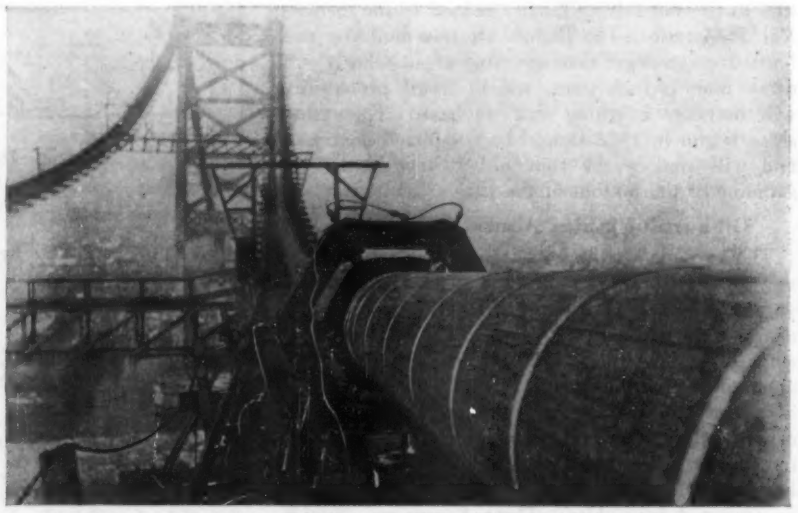
The anchorage foundations were constructed as open-dredged, reinforced concrete caissons sunk to rock. For each anchorage two rectangular caissons and twelve circular caissons were used. The rectangular caissons for the Camden anchorage were 40 feet by 140 feet in plan and 102 feet deep; those for the Philadelphia anchorage were 40 feet by 125 feet in plan and 55 feet deep. These caissons are believed to be the largest ones of their type ever constructed. They perform the heavy duty of transmitting to the bed rock the thrust from the two main cables. The twelve circular caissons are divided into two groups at each anchorage. Eight caissons, each 20 feet in diameter, support the mass of masonry which by its weight serves to anchor the cables. The remaining four caissons are 16 feet in diameter and are employed, two on each side of the anchorage, to support masonry towers that form part of the anchorage and in which are located stairways, elevators and utility spaces.

The most distinctive feature of the bridge is the cables, for, instead of using four cables, as in the great suspension bridges over the East River, New York, Mr. Modjeski has used only two cables, which necessarily are of great size. Each cable is 30 inches in diameter, as compared with 15½ inches in the Brooklyn Bridge, 18¾ inches in the Williamsburg Bridge and 20¾ inches in the Manhattan Bridge. In the Delaware River Bridge, the cables are composed of 18,666 strands of galvanized wire as against 5,296



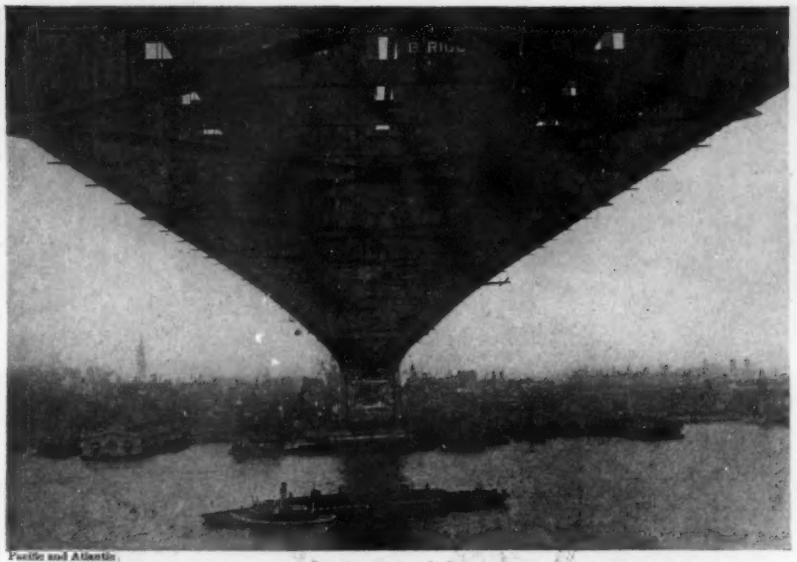
CLAMPING THE BANDS ON THE CABLE

After the mass of wire has been squeezed into a circular form, massive cast-steel bands are fitted around the cable. The loops of the vertical suspender cables which carry the floor rest in the two grooves shown in the photograph



SQUEEZING THE 18,666 STRANDS OF THE CABLE INTO CIRCULAR FORM

Here we see the very interesting work of squeezing the mass of wires of the cable into the circular cross-section. This is done by a jointed frame which is placed next the ropes and an outer rigid frame with hydraulic jacks which squeeze the cable to shape



Pacific and Atlantic

UNDERSIDE OF BRIDGE LOOKING TOWARDS PHILADELPHIA

This shows the deep transverse floor beams, which are attached to and supported by the stiffening truss. The diagonal members form the wind bracing and prevent lateral distortion of the floor due to side winds

GENERAL VIEW OF THE SPAN LOOKING NORTHWEST

Total length anchorage to anchorage 2,253 feet 4 inches of which 1,750 feet are in the main span. The floor is being attached to the suspenders. The unbalanced loading causes cables to rise at center. When floor was completed it came to a parabolic curve

in the Brooklyn Bridge, 7,696 in the Williamsburg Bridge and 9,472 strands in the Manhattan Bridge.

These suspension cables have an ultimate strength of 215,000 pounds to the square inch, the respective ultimate strength for the other bridges being 177,000 for the Brooklyn Bridge, and 210,000 pounds each for the Williamsburg and Manhattan Bridges. The weight of the Delaware River Bridge cables is 6,770 tons; for the Brooklyn Bridge, 3,272 tons, for the Williamsburg Bridge, 4,344 tons and 6,108 tons for the Manhattan Bridge. The strength of each of these cables is such that it could easily lift the *Leviathan*, weighing 54,000 tons, clear of the water.

In laying the cables, the wire was carried across the river on traveling sheaves or trolleys fastened to an endless cable. One end of the wire from a reel was fastened to a shoe at the anchorage and a loop passed over the trolley wheel. As the endless cable was set in motion, the loop was carried to the opposite shore, where it passed over an anchor shoe in the anchorage. This process was repeated until the whole mass of wires had been laid parallel with each other. They were then formed up into a cable of true circular cross section by means of a squeezing frame which encircled the cable and, by means of hydraulic jacks, forced it into shape. It was then encircled by steel bands or straps to hold it to the circular form. Then upon the cable were placed, at intervals corresponding to the panel points in the stiffening truss of the roadway below, a series of heavy cast-steel saddles, each formed with a pair of grooves in which the suspender cables were seated.

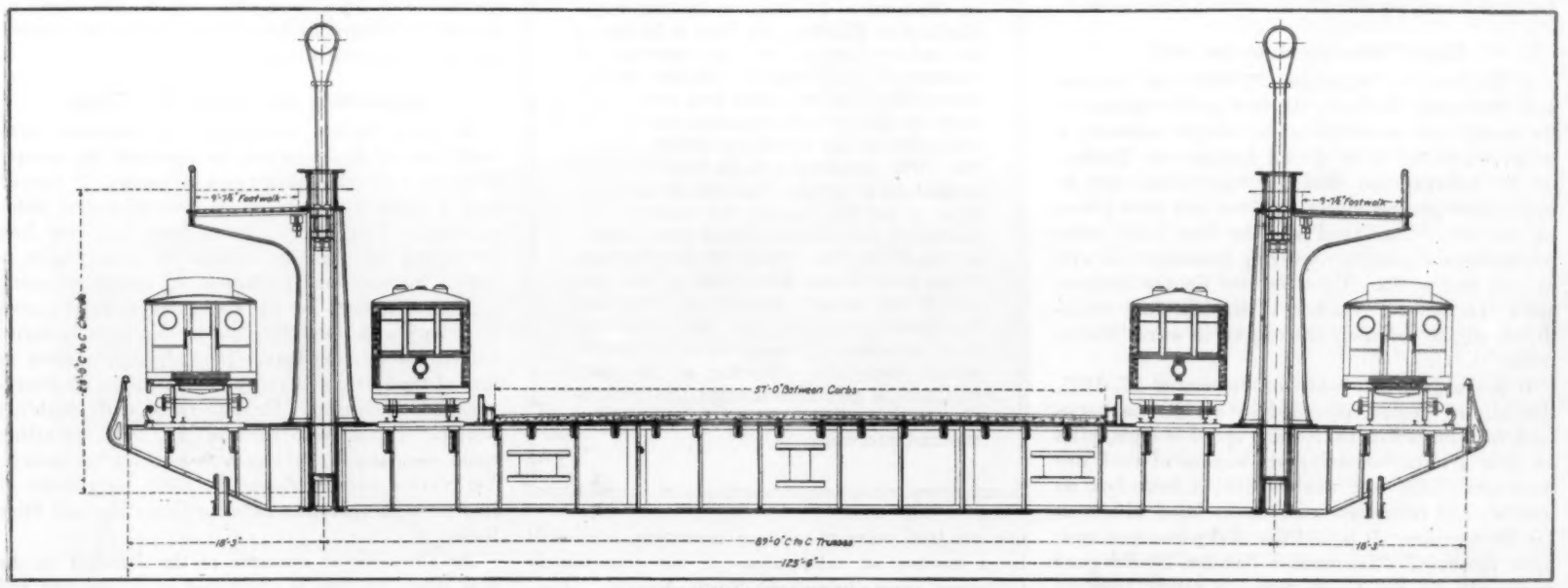
The cables are fastened to the anchorages by two sets of 122 steel eye-bars in each anchorage. These eye-bars spread out fanwise and are carried down into the concrete of the anchorage, where they are fastened to double-web steel plate girders, 40½ feet long and 4½ feet deep, there being nine girders to each of the four groups of eye-bar chains.

Cost Will Run to High Figures

The floor or roadway of the bridge is 125 feet, 6 inches in over-all width. Fifty-seven feet of the width of the floor is given over to vehicular traffic, and outside the roadway, adjoining the trusses, are tracks for two trolley lines. The floor beams are extended on each side beyond the trusses as cantilevers, and these cantilevers carry the tracks for two rapid transit lines. The vertical posts of the trusses are given lateral stiffening by two steel gussets, one on each side of each post and formed integrally with it, and those on the outside of the trusses are extended out to give a cantilever support for the two ten-foot wide foot-walks, one on each side of the bridge.

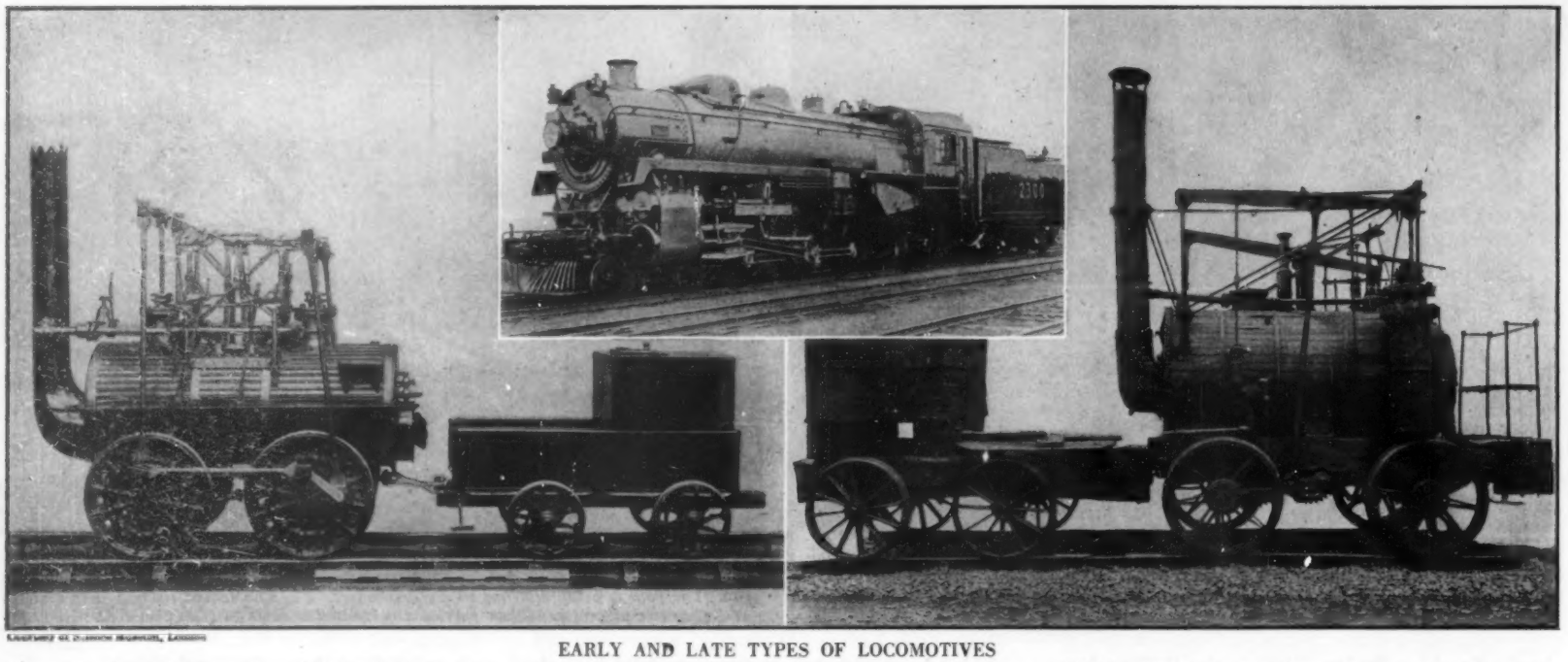
Our view showing the erection of the floor of the bridge illustrates the need of a stiffening truss to prevent deformation of the cables by the concentrated loads of the trains as they pass over the bridge. It will be noticed that the cables are depressed by the load of the floor extending out from the towers, but that they have been raised and flattened out in the center, where they are not loaded. Later, on the completion of the floor, the cables resumed their true catenary curve. The completed truss, by its rigidity, will hold them permanently to this curve.

The cost of the whole undertaking will run to very high figures. By the time the bridge is declared open, it will have cost about $37,000,000. Of course, the bridge itself will not cost any figure such as this. In fact the main bridge will cost about $15,630,000. But to this must be added the Philadelphia plaza, and approach, which will cost over $5,000,000, and the Camden approach, over $3,500,000. The engineering cost seems moderate in connection with these figures, being $1,500,000; and the administrative cost will be $350,000. The total construction cost of the bridge will amount to $25,924,003. Then $11,287,166 has been required for real estate.



CROSSECTION OF FLOOR

Width of floor, 125 feet 6 inches out to out. Width of central runway 57 feet. Provision also for two lines of trolley cars between the trusses and two lines of rapid transit trains carried on cantilever extensions of the floor beams. Cantilever extensions at the top of the posts of the trusses provide for two ten-foot foot-walks



EARLY AND LATE TYPES OF LOCOMOTIVES

George Stephenson's locomotive which hauled the first passenger train in the history of the world, September 27, 1825

Top view shows modern Canadian express passenger locomotive which drew the Prince of Wales' train across Canada

"Puffing Billy," the first locomotive to run with smooth wheels on smooth rails. It is now a national relic

The Centenary of the Railroad

Railroads in 1925 Will Celebrate Their One Hundredth Birthday

By Francis Dickie

THE year 1925 marks one hundred years of railroad operation. As the perfection of steam traction was perhaps the greatest factor in bringing about our modern civilization, this one-hundredth anniversary will be duly celebrated. The anniversary is particularly significant to the people of the North American continent; for in this vast land progress and settlement only began to make rapid headway after the advent of railways. Through steam transportation more than any other thing it was that the United States and Canada in some seventy-five years conquered the vastness of a wilderness continent, created homes for 120 million people, and became possessed of a general condition of comfort and luxury equalled by no other nation on earth.

Eight Miles an Hour in 1825

In England, on September 27, 1825, the Stockton and Darlington Railway, the first public railway in the world, was opened for traffic, and its centenary is to be celebrated by a special Congress in London, of the International Railway Association, and by appropriate proceedings in Stockton and other places on the line. This road was the first built under parliamentary powers, conveying passengers as well as coal and goods. Upon its line George Stephenson's "Locomotive Number 1" was the first steam-driven engine definitely introduced to work "Public traffic."

It was a great day when on September 27, 1825, this historic engine, preceded by a rider on horseback carrying a flag, hauled at a speed of eight miles an hour a train containing six wagons of coal, one passenger coach (the world's first, a mere box on wheels) and twenty-one coal trucks fitted with seats for the occasion. It is said that 450 passengers rode upon the train. "Locomotive Number 1" did good work. It did not break down—a rather frequent happening to engines those days.

While 1925 will be publicly accepted as marking one hundred years of railway operation, there will be a number of celebrations in the immediately following years throughout North America. Conflicting claims have appeared as to what constitutes the first railway. The oldest road in Massachusetts operated by steam is the Boston and Lowell, which was chartered in 1830. In 1926 Boston will celebrate the centennial of the "Granite Railway," built to transport granite by gravity and horse haulage a distance of four miles. The company which operated the first steam locomotive in America, the Delaware and Hudson, held its centennial in 1923.

In point of time the Pennsylvania Railroad is the oldest chartered railroad in North America by virtue of its charter being granted on March 21, 1823. It did not, however, start to operate until September 20, 1832. Colonel John Stevens is the father of the Pennsylvania, as he is the father of the American railroad in general. He was born in New York City in 1749. In 1787, having seen the imperfect steamboat of John Fitch plying on the Delaware, he became interested in steam propulsion, and experimented on this for the next 30 years.

Opposition and Doubt Met With

In 1825, Stevens constructed a locomotive with multi-tubular boiler which he operated for several years on a circular track upon his estate. It carried half a dozen passengers at the rate of twelve miles an hour. This is believed to have been the first locomotive in America driven by steam upon a track. Stevens died in 1838 at the age of 89 years.

Stevens' fight to get the Pennsylvania road started is a long and interesting story, too long, unfortunately, for relation here. It is almost the same as that of the starting of every railroad upon the North American continent. He was faced with doubting people. Funds were hard to get. The operating canal companies fought such threatening opposition. Yet Stevens succeeded, and by 1832, forty miles of line were in operation between Columbia and Mine Ridge.

An illuminating example of the disbelief in the new steam traction is illustrated in a very old and scarce print showing the test of speed between a horsedrawn vehicle on an operating line of iron

The First Practical Railroad

If one were asked to name the agents which above all others have contributed to the development of civilization during the past hundred years, he would be fairly safe in naming those two great means of transportation, the locomotive and the steamship. It is now some eighteen years since New York City celebrated the centenary of Fulton's *Clermont,* the first steamship to be put into regular commercial service; and in the present year, in England, will be celebrated the centenary of the opening, on September 27, 1825, of the Stockton-Darlington Railway, the first to be placed in public service for the carriage of passengers and freight. Earlier steamboats than that of Fulton had been built, both in Europe and America; but to him will ever be the credit for having placed the first successful passenger-carrying steamboat in service, running to schedule over a definite route. So, also, in the matter of the railroad, there were earlier locomotives than those of Stephenson. Each contributed something to the art; but it was George Stephenson who had the genius to select the best elements from previous locomotives, apply others which were the offspring of his own mechanical genius, and bring the locomotive to the point at which it was a commercial success.

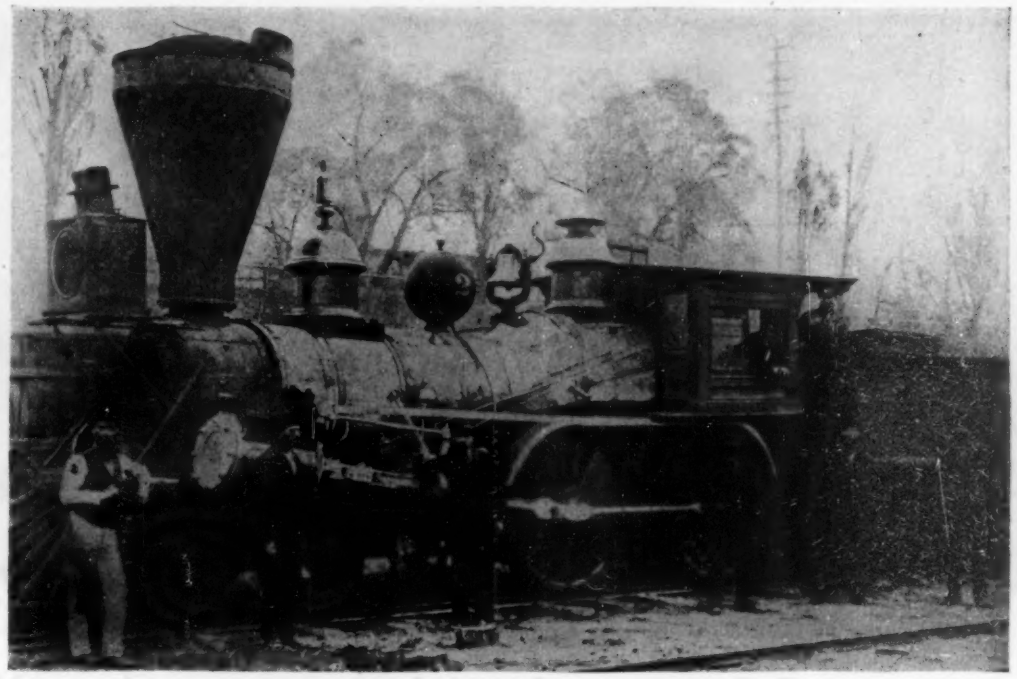
track and the first steam-drawn car. A mechanical genius named Peter Cooper had completed an engine known as "Tom Thumb." After months of endeavor he finally, on August 28, 1830, got a trial of it on the Baltimore and Ohio road against the regular horse-drawn vehicle. The engine quickly demonstrated its superior speed and power, and the new mode of transportation was accepted. In years of operation the Baltimore and Ohio is the oldest on this continent, and will celebrate its centennial in 1927.

The progress made in improving railroad equipment kept pace with the rapid expansion of the lines of track, which, after 1830, began radiating farther in every direction across North America. Marvelous advances were made in ever better passenger, sleeping and freight cars, and in locomotives. To illustrate all the phases of increasing comfort and utility which have come about in connection with passenger and sleeping coaches would alone require a thick book. But, as every traveled man and woman of today, who has reached the age of forty, has personally had the opportunity of making this comparison, this phase need not be further dwelt upon.

Bitterly Attacked by Politicians

In this article special attention has been given to the most important side of railroading: the improving of the steam locomotive. And as the technical details of construction cannot be incorporated in this limited space, and are, moreover, not particularly interesting to the average reader, it has been attempted here to more clearly convey the progress that has been made by carefully chosen illustrations of engines, ranging from 1813 to 1923.

While a steam railroad was first operated in 1825, engines driven by this power date back as far as 1804. Between 1804 and 1825, the following inventors had been experimenting in England, France, and Germany: Watt, Cugnot, Trevithick (the actual inventor of the locomotive) Hedley, Blackett, Blenkinsop, Hackworth, and Stephenson. The last-named built a satisfactory working engine in 1812, named "Blucher." Trevithick's engine traveled on rails at Merthyr Tydvil in 1804. But it was only after 1830 that the steam-driven engine can be said to have been an important factor in passenger and freight traffic.



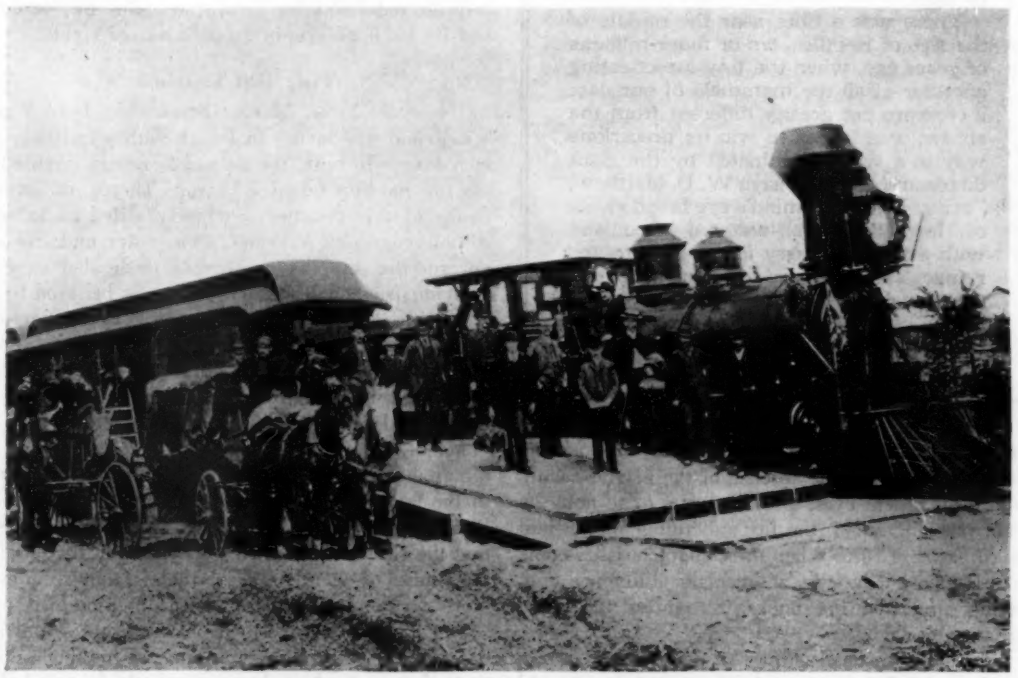
THE DAY OF WOOD-BURNERS AND BEARDS

One of the first passenger locomotives in Canada, starting on its maiden trip on May 16, 1853, on the Ontario, Simcoe and Huron Railroad

In the United States, railroads made great headway between 1830 and 1853. It was not until 1845 that the sparsely populated, and therefore poorer region of Eastern Canada, began developing railways. Herewith is shown the first passenger engine and the second locomotive in Ontario, belonging to the Ontario, Simcoe and Huron Railroad Union Company. It first ran out of Toronto on May 16, 1853, as far as Aurora, Ontario.

The building of Canada's first transcontinental, which was completed in 1885, was perhaps the most important factor in developing ever better rolling stock to meet the demands of 3,000 miles of travel. The story of the building of this transcontinental, the Canadian Pacific Railway, is—like the story of Colonel John Stevens starting the Pennsylvania—one of tremendous difficulties overcome; those placed by nature and by man. Never was a project more bitterly attacked by politicians. The builders of the Canadian Pacific risked a hundred million dollars to throw a line of steel across 3,000 miles of almost unpopulated territory. This was the first transcontinental in the world, and, for a quarter of a century, until the completion of the trans-Siberian, the longest line of track operated by one company. To the building of the Canadian Pacific's 3,000 miles of line, linking the Atlantic and Pacific seaboards, and the following branches throughout the country, is largely due Canada's great expansion in forty years from a sparsely populated wilderness to a prosperous nation, one of the greatest producers of wheat, lumber and minerals in the world.

Civilization and prosperity follow the locomotive as well as the flag!



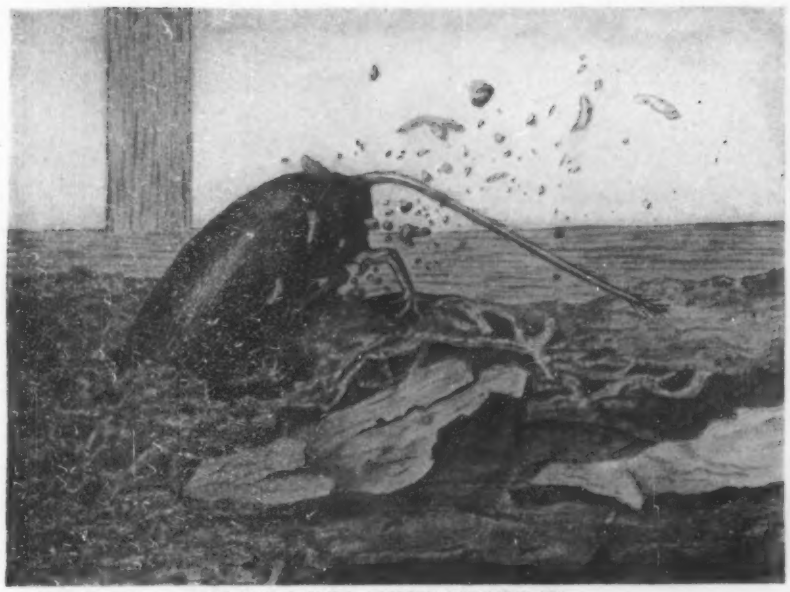
FIRST CANADIAN THROUGH TRAIN TO PACIFIC

This most interesting photograph shows the arrival at Port Arthur of the first through train from the Atlantic to the Pacific on June 30, 1886

Railways Promote Prosperity

The demands of so huge a transportation system naturally brought the mechanical staff continually new problems. Some of the finest mechanical genius in the world was gathered together to meet these problems. And as a result of their labors, the Canadian Pacific eventually began building their own locomotives. From the many types evolved, two striking examples are herewith shown by photographs; the second and the last locomotives of the company, representing 35 years of evolution. The engine shown at the top of the page represents the second locomotive in Ontario, and engine number 2300 (top of page 104), represents the last word in passenger locomotive construction up to 1923. This is known as "The Prince of Wales" Engine. In 1919 it drew the Prince's special train across Canada.

This, in brief, is the history of railroad progress, one particularly timely in the year which marks the hundredth anniversary of steam railroad traction. By the aid of locomotives and trains of cars mankind in that century of time has built up a civilization, which, in comfort, and in rapidity of transportation over long distances, so far outstrips all previous civilizations as to permit of no basis of comparison. In particular, the railway has been the chief factor in making North America what it is today: the richest country on earth. Through the expansion brought about by the iron trail, the United States and Canada in a century of time have become nations equal in civilization to the hundred-times more ancient nations of Europe.



LONG-TAILED SHREW DIGGING IN
In seeking shelter from an enemy the shrew can dig almost as rapidly as a mole

SHORT-TAILED SHREW CAPTURING A GRASSHOPPER
Grasshoppers, other insects and young mice are delicate bits of food for the shrew

Mammals Almost as Small as Insects

Habits and Characteristics of the Tiny Shrew, a Creature Which Is Little Known Because of Its Semi-subterranean Habits

By S. F. Aaron

Drawings by the Author

IT WAS a surprise to the observers who first penetrated the American tropics to find a spider large enough to capture some birds and these birds smaller than many giant insects. In the temperate zones of both the eastern and western continents there are representatives of a peculiar group or family numbering among its species perhaps the tiniest of all the creatures that suckle their young. These little mammals are almost as small as some of our common insects.

The great sand-hill hornet measures in length of body fully two inches; the giant Aeschna dragon-fly has more than four inches of head, a stout thorax and slender abdomen and the larger sphinx moths with their wide, strong wings present an even greater bulk. But the common long-tailed shrew, *Sorex personatus*, rarely reaches a total of over three inches with a tail an inch and a half in length. The girth of the little creature, with its soft, dense, seal-like fur removed, is less than that of the thorax of the dragon-fly.

No Visible Creatures so Seldom Seen

Astonishment at its diminutive size is the first impression felt by the novice who takes a dead long-tailed shrew in hand. The delicate-appearing little thing seems altogether too insignificant to be of the same general physiological make-up as the lion, the Kodiak bear, the walrus or the elephant.

No visible creatures, except the moles, are so little known, so seldom seen as the shrews. The moles can be traced in part by their subterranean pathways, but the shrews, though tunnelers also, hardly have a definite objective. It is not size alone that makes the shrews strangers to most people, even to the woodsman and the farmer. Hidden ways, a resemblance to surroundings and its general mouse-like aspect account for the shrew being so seldom specifically noted.

Now and then the casual observer living in the rural districts will take a shrew from the mouse trap and thoughtlessly identify it as a young mouse. He fails to observe the absence of the bright, round, prominent rodent eyes, the lobed ears or to note the long, tapering snout, the far underhung mouth and the soft coat of fur. When these characteristics come to his attention he sees at once the difference and, having consulted the books, recognizes the unfamiliar shrew.

I have shown dead shrews to more than a dozen woodsmen and farmers and not one of them could say that he had seen the creature before, though no doubt some of them had; in traps, or in the jaws of cats who will not eat it because of the rank, musky odor.

This strong odor of the shrew, together with its semi-subterranean habits, protects it and accounts for its numbers in every locality. It is a lover of the dark, making long tunnels beneath fallen tree trunks, about the roots of old stumps, often around the bases of living trees growing in loose soil, beneath flat surface stones and bits of fallen, heavy bark, seeking also the burrows of wood mice and venturing to forage more broadly under the carpet of woodland leaves. Even the larger, short-tailed shrew, known also to naturalists as the mole shrew, is protected from its natural enemies by its odor and its habit of keeping warily out of sight.

Tiny But Fearless

The mole shrew, *Blarina brevicauda*, is four and a half and five inches in length with a tail only an inch long. In bulk, the animal is nearly double the size of its long-tailed relative. There are several forms of this creature so closely allied as to constitute geographic varieties. The color and size are not specific and the number of teeth also vary in individuals, though formerly this was believed to be a specific character more constant, and therefore, important. Southern varieties of the mole shrew are smaller in size—a climatic rule that holds good not only with the shrew but with other varieties of four-footed animals.

Most of the interest concerning the shrews is centered in their savagery and indomitable bravery; in the latter respect they compare with the fearless little humming-bird among the avian fauna, except that the shrews are not so well endowed for eluding the attacks of enemies. Nevertheless, they seem even more recklessly fearless. The humming-bird possesses more native wit; it is cognizant of actual dangers, while the shrews, relying far too much upon their deterrent odors, have very little fear and thus they become the prey of shrikes, hawks and especially the nocturnal owls, these undiscriminating

Ten Million Years Ago

Just as man is believed by science to have evolved from a monkey that lived several millions of years ago, so it is believed that man, together with the anthropoid apes, the living monkeys, and the lemurs, have in turn as their common ancestors one of the little shrews, resembling, perhaps, a species of tree shrew that is found in Africa.

The tiny shrew, then, is a cousin to man.

There was a time near the middle of the Age of Reptiles, ten or more millions of years ago, when the tiny insect-eating ancestor of all the mammals of our day, a creature not greatly different from the shrew, was forced to win its precarious way in a world dominated by the giant dinosaurs. "This," says W. D. Matthew, "brings before the mind's eye broad vistas of low-lying, well-watered woodland with ever alert, furry forms taking such refuge as the trees or shrubbery or occasional hiding holes could offer, in the midst of stalking terrors such as the world never saw before nor since."

killers possessing no epicurean tendencies. No doubt, weasels, minks, skunks and opossums kill and devour shrews, though no visual evidence of their doing so has been found. It is not uncommon, in the wilder sections, to see weasels with captured moles and mice. I doubt if the more fastidious bear, bobcat and raccoon ever touch the ill-smelling shrews, although they may destroy them as mice, discover the difference later, and leave them to be devoured by birds of prey.

Shrews are largely carnivorous, feeding on the developmental stages of terrestrial insects and on those that hibernate near the ground, including to a great extent the grubs of beetles, crickets, cut-worms, crane-flies and cicadas. Shrews follow the runways and burrows of mice and with a savagery exceeding the weasels they attack and kill the rightful inmates, feeding also upon their young. The small rodents seem to regard these marauders much as the rabbit and squirrel do the weasel and mink, though occasionally in defense of the young the larger mice will oppose the shrew, but with what success can only be conjectured. When roomily caged together a white-footed mouse easily avoided a long-tailed shrew for a time and then as easily shook it off when the latter managed to corner the mouse and seize it. Doctor Edward W. Nelson tells of both species of shrews killing mice and similar incidents are mentioned by other reliable observers.

Attracted to Anything Edible

Vegetable food, such as small seeds and larger grains of various kinds are also eaten by shrews; they seem to be attracted to anything edible. Mouse traps baited with cheese are sure to get them in their runways or about buildings, especially cellars, which they often enter in winter. They do not seem to possess the vitality of mice, for a spring trap kills them instantly, always without a prolonged struggle. They are attracted to granaries and in such situations especially, they confer a distinct benefit because of their destruction of insects and young mice, the grain they eat being negligible.

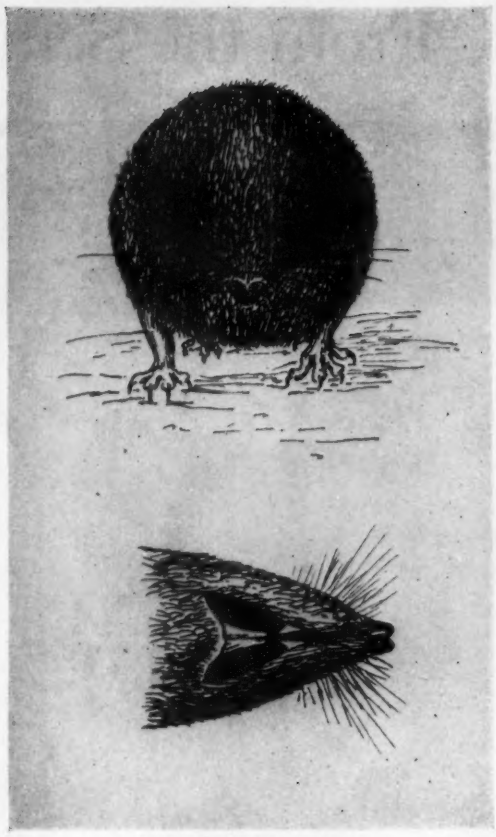
The boldness of shrews, even when they are not cornered and they have a chance to escape, is phenomenal; their poor sight may in part account for this. Sound seems to alarm them most; a jar or footfall sends them to cover, no doubt an hereditary

READY FOR BATTLE

A long-tailed shrew about to attack a white-footed mouse. The shrew follows the burrows of mice and kills them with savagery

experience from fear of being stepped on by a larger animal. But when there is food near by, or their anger has been aroused by capture, even though they may be somewhat injured but not disabled, they will refuse to retreat and seem almost to court attack.

Our well-fed old cat, a great mouser and an eager killer of cornered and savage rats, occasionally brings in a shrew, which he merely catches as a sort of duty, though he rarely injures the little creatures. By this means I have been able to examine shrews in a manner otherwise hardly possible. It has been



SHORT-TAILED SHREW

Upper: What the field or pine mouse may see coming along the burrow. Lower: Under side of head, showing position of mouth and incisor teeth

no trouble to take them from the cat after he got past his kittenhood; they are so distasteful to him that he will drop them and walk off. One short-tailed fellow the cat left by our porch steps; he had played with it, picked it up in his mouth now and then, but had instantly shaken it loose when it bit him. In this case ,too, the shrew was doubtless protected by his odor.

This captive may have come to the conclusion that it had defeated the cat finally; it was so chesty that it actually came out from under the lower step and when I poked my foot at it, gently, it very promptly showed fight, leaving its tiny teeth marks on the edge of the sole, nor would it retreat farther. Another, discarded on the cement walk, ran about rapidly, seeking some shelter; it stopped every little while to try to dig itself in and finally did so in the sod under the edge of the walk, almost as rapidly as a mole would have done. This also was a short-tailed shrew; its forefeet are broader than those of the long-tailed and a little better adapted for digging. The smaller animal digs rapidly, but only in the soft mold of woodland soil. It would have little opportunity for escape from pursuers if chased into the open.

Food Keeps Up Body Temperature

Active throughout the year the shrews hunt under the snow and generally remain in deeper burrows, or under thick piles of wind-driven leaves when the ground freezes. Sometimes, in the eager search for food, they find openings through the snow to the surface and they venture forth, their dark fur against the white offering an easy mark for birds of prey. Then they may lose their way and fail to find another means of going below. At such times becoming quite frantic with hunger the diminutive explorer gets utterly bold, dashing here and there with a speed that seems incredible considering its size. It leaps at the observer's feet and at other black objects, as though these are holes that lead to safety. Finding no food it grows gradually slower in its movements and within a short time, possibly an hour, it stops, stiffens and as suddenly dies, the body heat when denied frequent sustenance rapidly diminishing, and the wintry cold putting in its work.

This fact, which has been observed more than once, has led to the notion that shrews must have food very frequently or starve, but this is proved a fallacy by the fact that in warmer weather, when a fatal lowering of the body temperature does not take place, they can abstain from food for many hours and remain active. They cannot, however, go without food for any extended length of time.

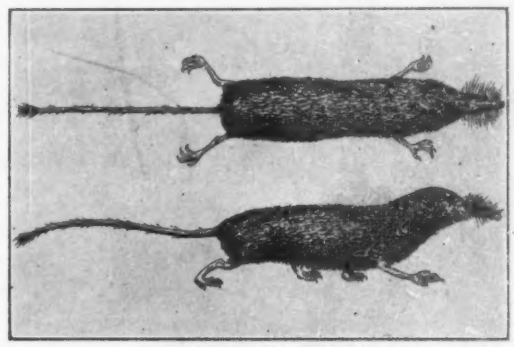
By caging a gravid female shrew I was once able to study the nesting habits of the short-tailed species. The food supplied—bits of cheese, cake, bread, small pieces of raw beef, some freshly killed and live insects, a little cooked oatmeal—was all sampled, the little creature evidently preferring flesh, although no doubt this kind was an entirely new and unfamiliar item of food.

The Shrew's Underground Home

Burrows were made through and through the leaf mold in the cage. Only once did I witness the digging and then the bits of bark, pebbles, sticks and dirt flew into the air with a force that carried them beyond further bother. Deeper in the hole, I think, the surplus earth was packed on every side, as is practiced by chip-munks, gophers, spermophiles and even the woodchuck.

In about the center of the cage, near the surface of the leaf mold and beneath a piece of bark the shallow nest was made—a rounded depression about two inches wide and as deep. It was made smooth inside by the compression of the material, but was not lined nor bedded, though soft grasses and moss had been placed near. Before the young appeared the expectant little mother was injured by preventing her escape when food was being put into the cage and she had to be killed, so that I have not seen tiny new-born shrews.

The nests of shrews may often be found in such sheltered places as will insure their safety from natural enemies. They are commonly made of grass leaves, dried but somewhat flexible and they are matted together in a more or less compact mass not unlike the small nests of the meadow and jumping



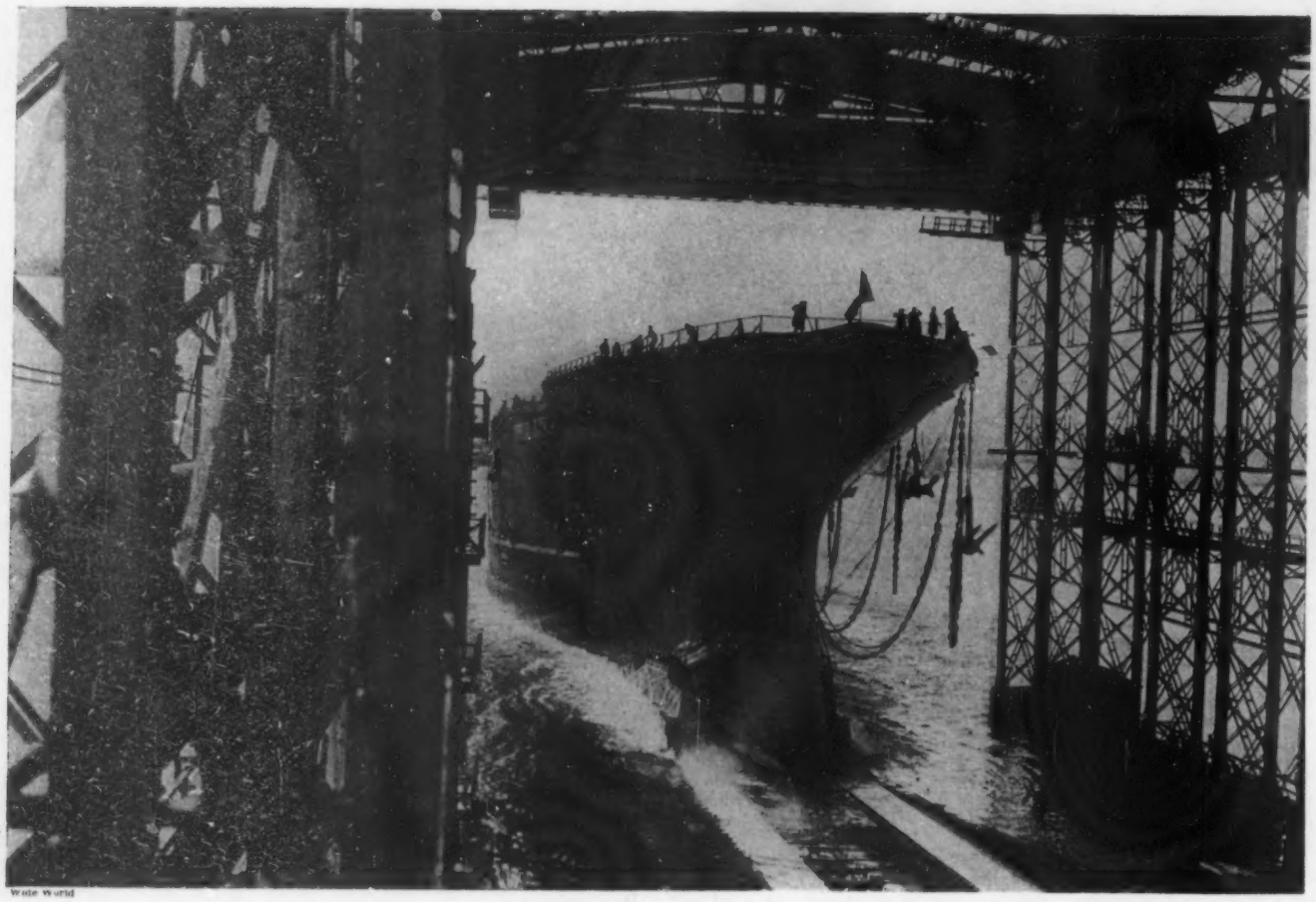
LONG-TAILED SHREW

Upper: Back of dead specimen resembles a grotesquely stuffed animal. Lower: Side view. Note insectivore snout and underhung jaw

mice. Shrews are said to have several litters of young during the season of mild temperature. Their habits may best be studied in large cages with natural conditions. They must be supplied with abundant and varied food, for they have enormous appetites in proportion to their diminutive bodies.

They will be found to be more active at night than during daylight and it will be observed that they depend far more upon their keen noses in going about and detecting food than upon their evidently inferior and perhaps nearly sightless eyes. One may well marvel at his resourcefulness and courage.

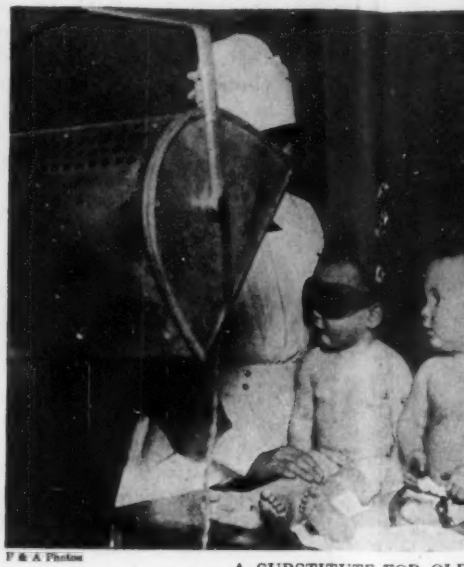
From the Scrap-book of Science—Came



Wide World

THE WORLD'S LARGEST AIRPLANE CARRIER

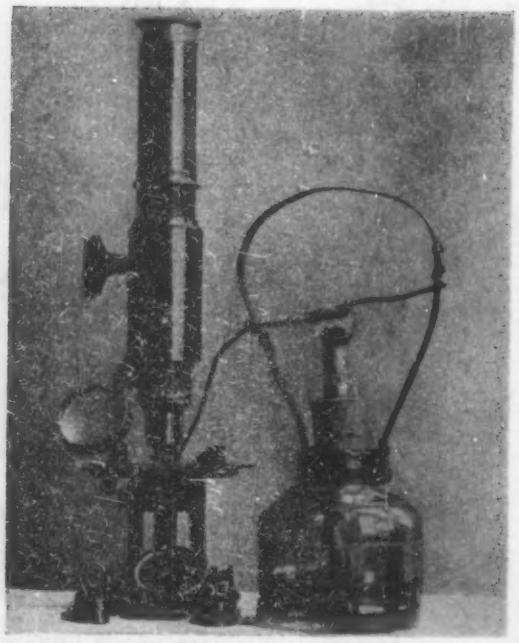
The launching of the U. S. S. Saratoga at Camden, New Jersey, was a notable occasion. Commenced as a battle cruiser, she was completed as an airplane carrier. The vessel, is 874 feet in length over-all, has a beam of 104 feet, and will be driven by the most powerful propelling machinery ever placed in a warship



P & A Photos

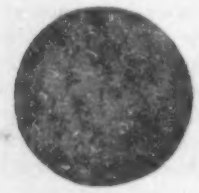
A SUBSTITUTE FOR OLI

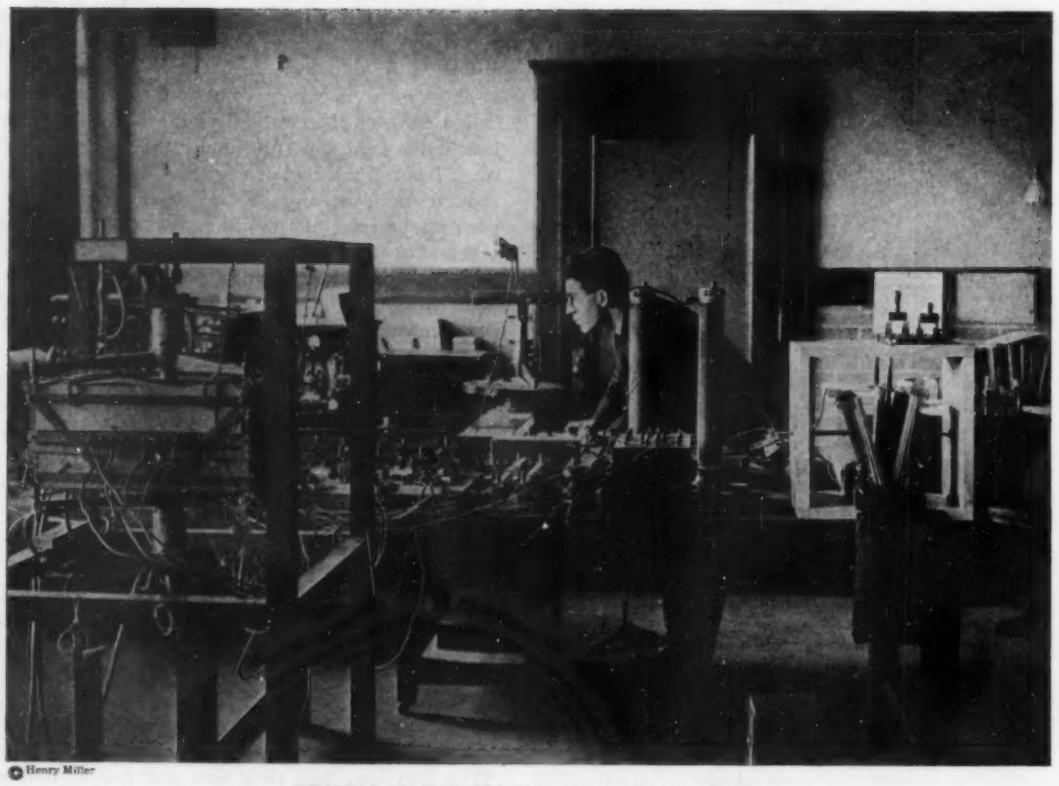
Infants suffering from rickets being treated with ultra- The rays are equivalent to artificial sunlight and their



HEATING MICROSCOPIC OBJECTS

The copper wire leads heat from the lamp to the stage of the microscope, so that objects which require to be heated while being observed can be examined at leisure. The microphotograph at the left shows crystals of ferric chloride (chloride of iron) formed and photographed on a heated microscope stage like that shown above. Many salts and other chemical compounds can be examined in this manner while they are being melted or crystallized





Henry Miller

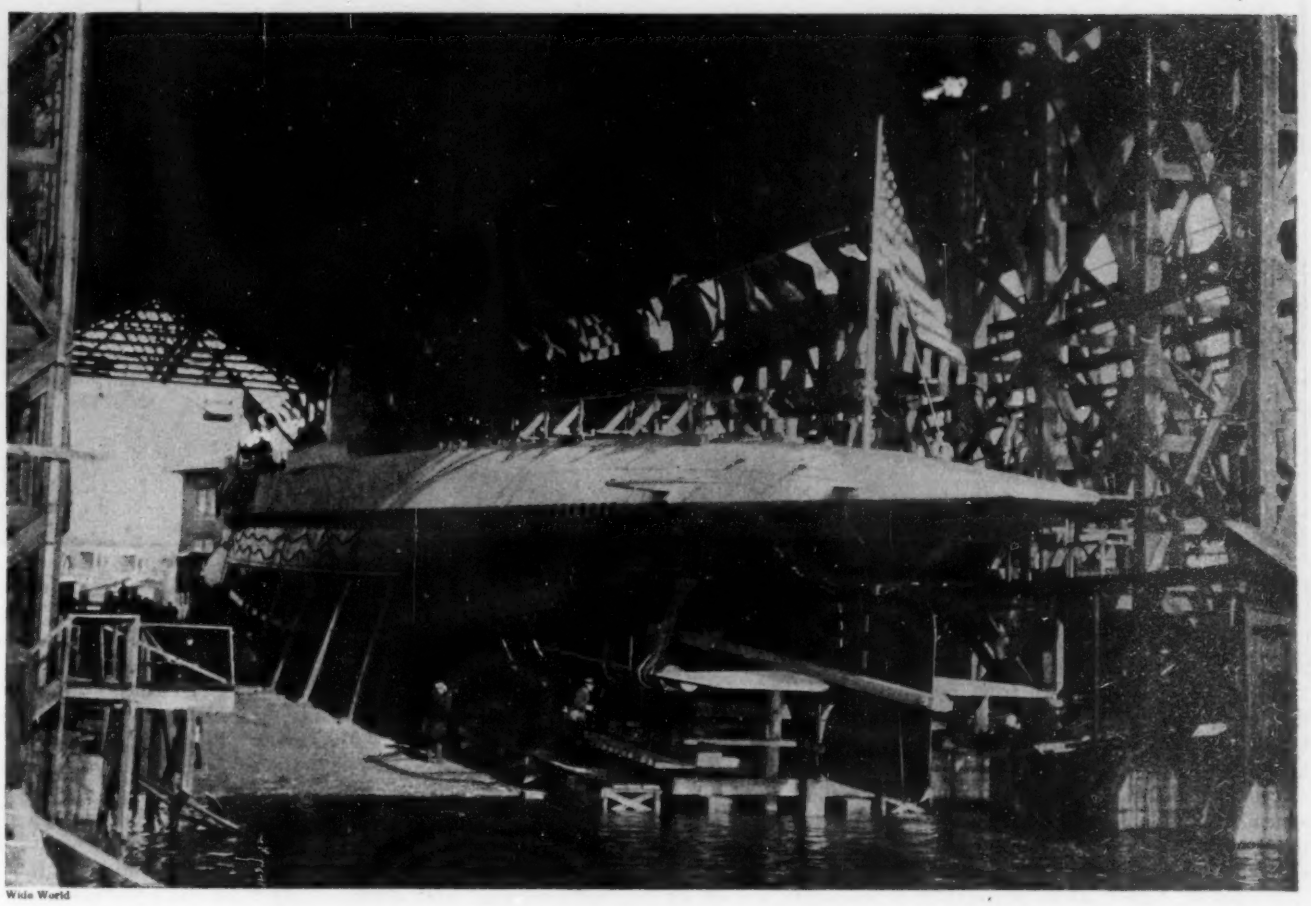
TESTING MATERIALS FOR HEAT INSULATORS

Dr. F. L. Fink, of the Bureau of Standards, conducting an investigation on the transfer of heat through insulating material. An extremely complicated electrical apparatus is set up at the bureau in its efforts to determine this. The apparatus at the right is used to conduct tests on material such as celotex, shown in the photograph. It consists of a hot plate in the center in which heat is generated. On both sides of this hot plate samples are inserted to be tested. The two external plates are hot water plates, so constructed that water at constant temperatures can flow through them. In the operation several plates are compressed and the reading can be made from the potentiometer

Camera Shots of Scientific Happenings

ITUTE FOR OLD SOL

treated with ultra-violet rays in a London hospital. unlight and their use has been amazingly successful



Wide World

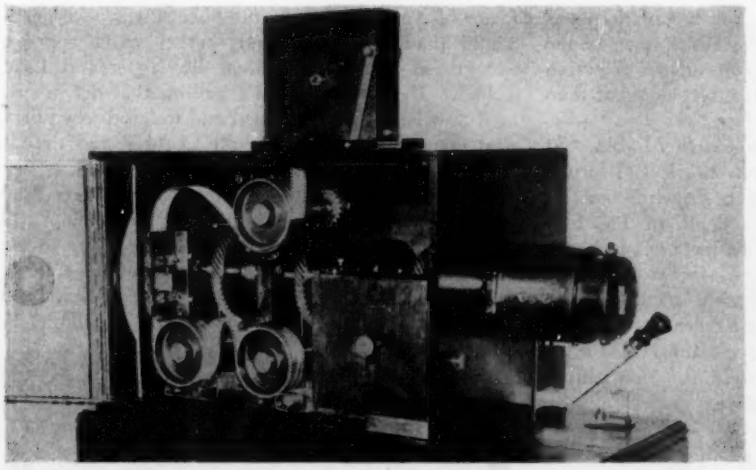
HUGE SUBMARINE

This beautifully stream-lined craft is the Navy Submarine, V-2, photographed just before her launching at the Portsmouth, New Hampshire, Navy Yard. Note the flattened stern and the horizontal rudder which serves to direct the ship upward or downward. The conning tower, bridge and superstructure is seen at the center of the ship

Kadel and Herbert

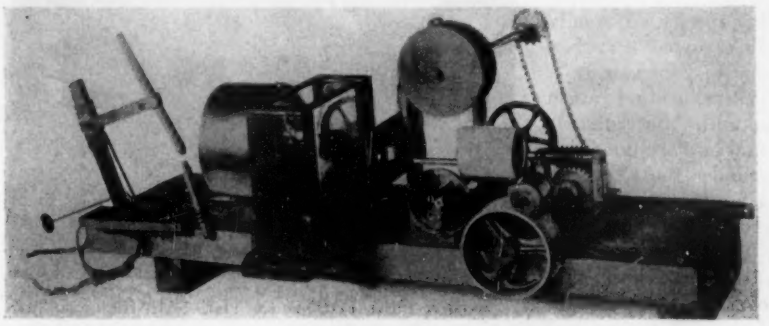
A FLIVVER AIRPLANE

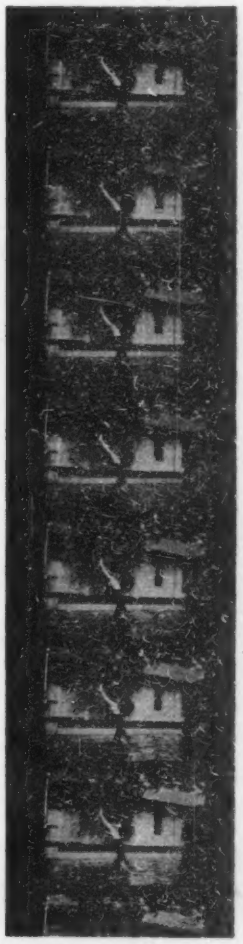
Germany is making great strides in the manufacture of these aerial flivvers. The above photograph shows Prince Heinrich of Prussia, brother of the former Kaiser, inspecting the miniature motor in one of the small planes that recently took part in a competition in Germany. Prince Heinrich was one of the judges of the competition

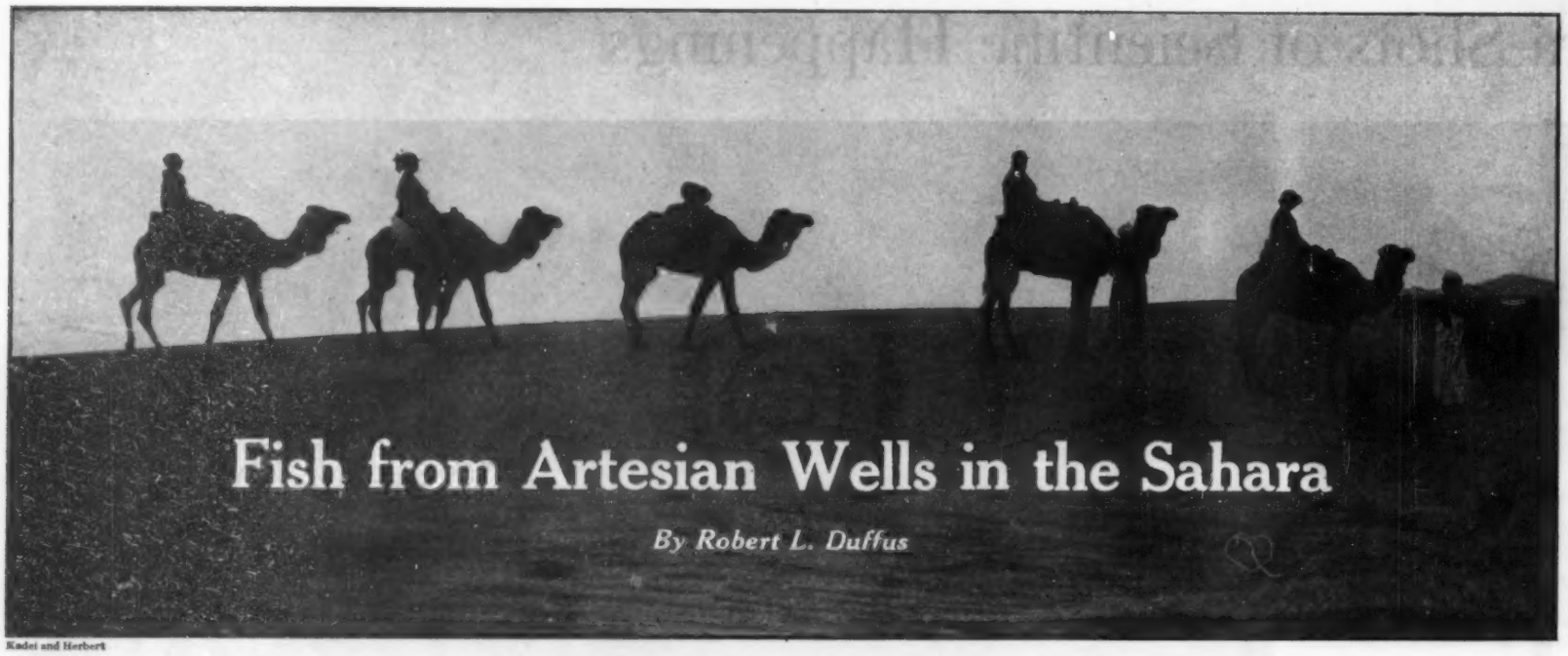


NEW CAMERA TAKES 3200 PICTURES A SECOND

The camera shown above, invented by Mr. C. Francis Jenkins of Washington, is reported to have this tremendous speed. At the right is a series of photographs of a diving girl made so rapidly that scarcely any motion is shown. Below is Mr. Jenkins' original motion picture machine, the prototype of the machines now used







Fish from Artesian Wells in the Sahara

By Robert L. Duffus

Kadel and Herbert

A FEW months ago newspaper correspondents in Algeria thought it worth while to pay cable tolls on reports that "small crabs, fish and shellfish" had been found in water from artesian wells in the Northern Sahara. Some skeptical readers may have passed this by as of a piece with sea serpent fiction. Yet the facts were not only as the despatches stated, but they have been well known to scientific men for more than sixty years—in short, ever since the French bored their first wells in the desert country south of the Atlas Mountains. They tell the story, not of Algeria alone but of half a continent and of hundreds of thousands of years of geologic change. For those who can understand his language the little *Haplochromis desfontainesii* (this happens to be the pet name of one of the best known of the fish species found) who pops out of an Algerian well when he is not expected is more eloquent than any political spellbinder.

This phenomenon is not confined to Algeria. At Point Hueneme, near San Buenaventura, California, an artesian well was drilled on the beach about five feet above high tide mark to a depth of 143 feet, whereupon young trout about two inches long began to be thrown up by the thousand. In eyes, coloring and other characteristics they were identical with those found in the nearest stream, several miles distant. Similar instances have been reported from the Santa Clara valley, near San Jose, California, and in d'Arveyres in Southwestern France.

Underground Fishes

Most of us doubtless think of underground fish as resembling the blind or even eyeless species found in such places as the Mammoth Cave of Kentucky, but the remarkable fact about these fish from artesian wells, whether in the Sahara or elsewhere, is that they are almost always exactly the same as surface fish of the corresponding species. The only reported exception to this rule occurred near San Antonio, Texas, where, according to Professor J. T. Patterson of the University of Texas, a blind catfish was thrown up by an artesian well. But as some surface catfish, like their namesakes, "are nocturnal in habit," living "in crevices, under rocks, stumps and such," this discovery did not prove that Professor Patterson had found a distinct underground species.

The testimony of French scientists who have studied the Sahara fish is overwhelming on this point. In every case the eyes are well formed and the colors are as bright as those of the fish in surface waters. Since every living organism tends to adapt itself to its environment, this can mean but one thing—that the subterranean life in the waters which feed the artesian wells has not been long out of touch with the surface. So, the question arises as to how the fish penetrate to these depths and how they manage to live there.

To find an answer it is necessary to have in mind the nature and geological history of the Sahara. The hinterland of Algeria extends from the Atlas Mountains (which are geologically a European range cut off by the Mediterranean) over a region larger than France and nearly all desert. According to Dr. Jacques Pellegrin, the leading authority on the fishes of Northern Africa, the Sahara was once much wetter than it is now, and several water courses, now dried up, emptied into the Niger and Lake Tchad. The Arabs have a tradition that the desert, as it now is, was well wooded and watered when they first entered it in the Seventh Century and that it did not dry up until the Thirteenth Century.

A number of fantastic theories have received credence. A Scotchman, Donald McKenzie, proposed in 1875 to cut a twelve-mile channel from the Atlantic Ocean to the coast southeast of the Canary Islands, and so allow the sea, as he believed, to form a vast inland lake which would completely revolutionize the climate of Northern Africa. Another project has been to cut a channel from the Gulf of Gabes, in Eastern Tunis, which would also, it was believed, restore an ancient Saharan sea. Scientists are almost as cautious about these possibilities as they are about the canals on Mars, but they admit that the salt marshes at the base of the Atlas Mountains are survivors of much larger bodies of water.

Courtesy of Dr. E. W. Gudger of the American Museum of Natural History

FISH FOUND IN THE SAHARA

Barbus figuensis, hemichromis bimaculatus, zilapia zilli

In certain parts of the desert there are dried-up water courses to which the Arabs give the name of "oued," which means either "river" or "a place where water has been." Two of these, the Oued Mia and the Oued Irgharghar, come together near Tugurt to form the Oued Rir, and it is precisely at this point that the Arab well diggers, and later the French, have been most successful in finding water. The natural conclusion is that the waters of the Sahara, sinking beneath the sand as the climate grew increasingly arid, still follow the old courses. The fish life, once very numerous, must have found its quarters more and more constricted and been compelled to exist, not only in surface pools and the few remaining streams, but in many cases in the underground waters.

An Honorable and Dangerous Profession

It is unlikely that these waters, in the Sahara, are real underground rivers. They probably seep through the loose sand for the most part, forming pools and channels only when they encounter rocky caves and basins. The fish are, therefore, unable to move about freely over great distances. The fact that this must be the case, and the additional fact that they have still remained identical with species as remote as the Nile and the River Jordan is another indication that the drying up of the Sahara and the destruction of the old river systems occurred in comparatively recent times.

Although there are traces of ancient Roman wells in the Sahara, the greater part of the well digging has been done by the Arabs and the French. The French, with their modern machinery, are responsible for such blossoming as the desert has done in the past sixty years. The romance of these wells, both ancient and modern, is a story by itself. One of the most honorable as well as the most dangerous of Arab professions in days gone by was that of well digger. Some of the wells went down as far as 160 feet, piercing a layer of hard pan, under which water was generally found.

The first French observers were inclined to think

that the fish, crabs and mollusks brought up from these wells spent their whole lives underground. More recently they have been of the opinion that in some way this subterranean life maintained communication with the surface. Dr. Edouard Blanc noticed that fish from the wells were generally reduced to skin and bone when found, and believed that the minute algae, small crustaceans and other organic debris found in the water was not enough to keep them alive indefinitely. He, therefore, reached the conclusion that the wells were breeding places, where the young fish grew up, safe from the dangers of the open pools.

In the older wells pools and channels of considerable size are probably formed, so that there is plenty of room for fish of small size to develop unmolested. This would account for the fact that most of the fish taken from the wells are very small. As they grew larger, according to Dr. Blanc's hypothesis, they probably found their way to the surface pools by way of connecting channels.

This theory is satisfactory in most instances, although it leaves some puzzling facts unexplained. For example, it does not clear up the presence of fish in wells which have no surface pools, nor does it account for their existence in water too warm for long survival. The small trout thrown up at Point Hueneme, California, came from water at a temperature of sixty degrees, in which they could not possibly have lived for any length of time.

But the greater mystery is the identity of the species found in the Sahara wells with those not only in Central African rivers and lakes, but even in Palestine. A certain fish belonging to the *Chromids*—so called because of their vivid coloring—is found in the Sea of Galilee as well as in Algeria. Its distinguishing trait, in environments now completely dissimilar, is its habit of carrying its eggs in its mouth while they are hatching out. Other species found in the Algerian wells are exactly the same, not only as the fish of Palestine, but as those found in the waters of the Congo, the Niger, the Senegal, the Nile, Lake Tchad and Lake Tanganyika.

The Saharan Fish a Traveler

This brings us to some peculiar facts about the distribution of Northern and Central African fish, and perhaps to a solution of the problem. Out of 101 known species in the Nile forty-six are found in the Niger, the Senegal and the Gambia, and most of these latter are also found in Lake Tchad. One-fourth of the species found in Lake Victoria are also found in the Nile, and four-fifths of those found in Lake Rudolph are found in the Nile. Putting it another way, of sixty-six species of fish found in Lake Tchad or its tributaries forty-five are found in the Nile, thirty-eight in the Senegal, twenty-four in the Congo and seven in the Zambezi. There is only one explanation of such facts as these. They indicate that within a comparatively recent time fish were able to pass from Lake Tchad to and from the rivers named.

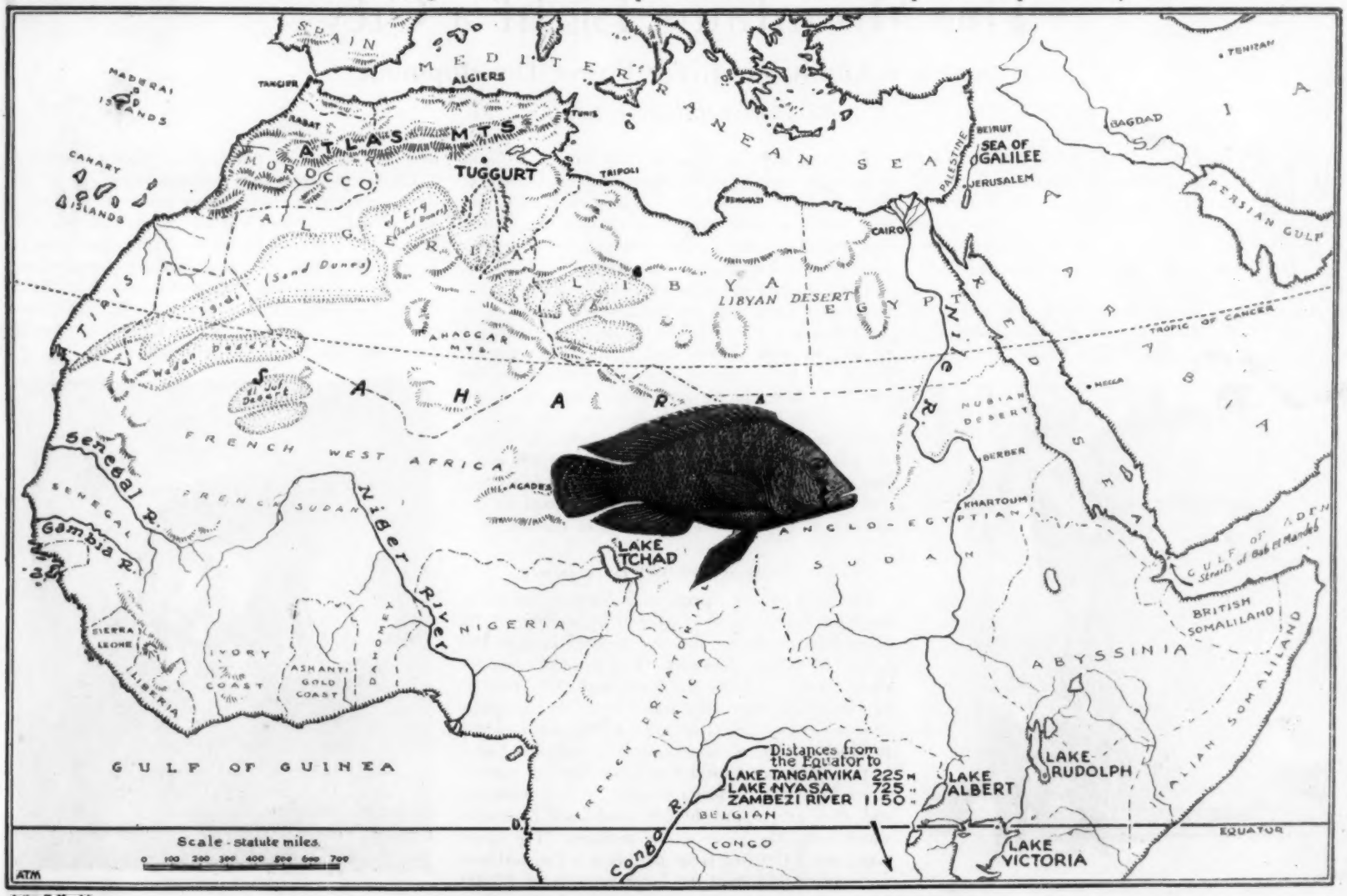
Where the Saharan fish are also found in the waters of the Lake Tchad basin, of the Nile and of Palestine a similar conclusion naturally follows. Not long ago, as geologists measure time, the *Chromids* of the Sahara were able to make their way by an all-fresh-water route to Palestine.

The reason for his present isolation is to be found in gigantic changes in the earth's structure occurring along a line running, roughly, from Lake Nyasa, through Lakes Albert and Rudolph to the Red Sea, the Dead Sea, and the Sea of Galilee. This is what is known as "The Great Rift Valley."

The Rift valley was formed by a double line of faults, or cracks in the earth's crust, which allowed a block in the middle to drop. This great change probably began in the Eocene period and continued during the ages that followed. Its effect, as in the plateau region which once occupied the present site of Lake Victoria Nyanza, was to "behead" a number of rivers which had once flowed out. There is good geological and zoological authority for the opinion that before this catastrophe there was a connection between the rivers of Palestine and those of Central Africa.

At that time, very likely, the waters of the Mediterranean did not come as far east as they do at present, and a Palestinian river may easily have flowed into the Nile. Another theory is that a river flowed from Palestine, along the trough of what is now the Red Sea, and formed part of the Central African river system. This supposition is supported by the fact that some species are found both in the River Jordan and in the Central African rivers, but not in the lower Nile, below the cataracts.

Lake Tchad, Dr. Pellegrin thinks, was a sort of clearing house for the fish of the Nile, the Niger, the Senegal, and probably also of the region which is now the Sahara. It is a little difficult to form an accurate picture of Northern Africa in this period. Yet we can certainly think of it as much wetter than the present-day Africa, and with a much more complicated and profuse array of rivers and lakes.



Arthur T. Merrick

WAS THIS VAST DESERT ONCE A WELL-WATERED PLAIN?

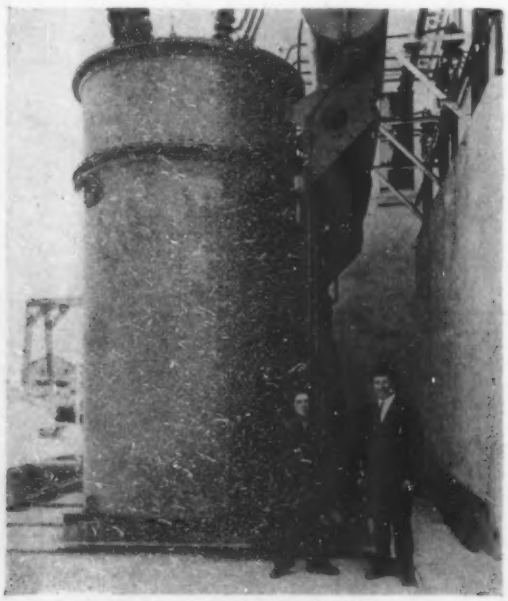
The little fish (haplochromis desfontainesii) was recently discovered in the artesian wells located at Tuggurt

The Mountains Light a City

Seattle's Ambitious River Power Development

By Thomas R. Horner, F.R.G.S.

TO meet the pressing demand of its growing population and industries for more electrical power, the city of Seattle has recently completed and is now using the first unit of the Skagit River project. This is the beginning of what eventually will be one of the largest power developments in the world, producing 600,000 horsepower at an estimated cost of $57,000,000. It will produce twenty-five percent more power than Muscle Shoals.



AT THE POWER HOUSE
A 65,000 volt single-phase transformer

The Skagit River is about 125 miles long with a drainage basin of 3,500 square miles. It rises in the Canadian Cascades, flows south into Washington, and turning westerly enters Puget Sound near Mount Vernon. The entire valley tributary to the power plant is very rugged and mountainous.

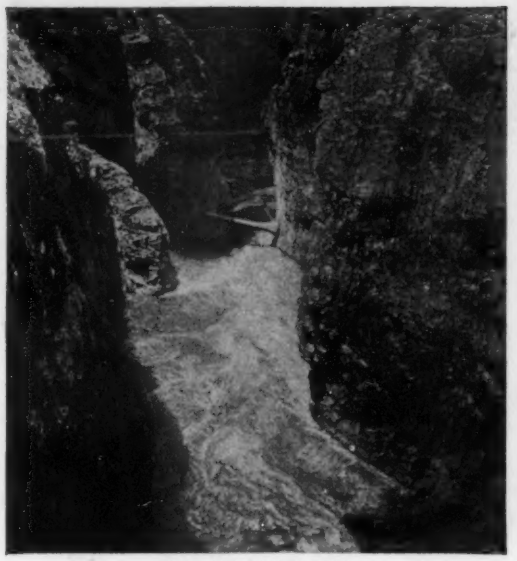
The watershed above the plant covers 1,200 square miles with an annual precipitation of 70 inches in the valley and 150 inches in the mountains. Owing to the mountain climate and to the dense forests, this is but little affected by evaporation; hence the Skagit, considering the size of its catchment basin, is one of the largest rivers in America. The average yearly stream flow of 4,547 cubic feet a second at the plant has been known to decrease to 800 cubic feet per second when checked by freezing in winter, and to swell to over 50,000 feet per second by the melting of glaciers and snowdrifts in summer.

To Produce 600,000 Horsepower

The unit now in operation is located 105 miles north of Seattle, and is reached by a railroad 26 miles long, built by the city to connect with the Great Northern at Rockport. Two parallel concrete-lined tunnels, 11,000 feet long and 20½ feet in diameter, will carry the water from the diversion dam at Gorge Creek, four miles to the north, to the penstocks. One of these tunnels is completed and in use and has a capacity of 3,000 feet per second at a velocity of nine feet a second. At their southern end they are tapped by six steel-lined penstocks which carry the water to the turbines. The surge tanks are 1,100 feet from the plant. The turbines are vertical and have the large capacity of 37,500 horsepower each under a normal head of no less than 375 feet with ninety-three percent efficiency.

The Gorge Creek unit, however, is but one of the three contemplated in the entire plan. As the Skagit is a torrential stream, it is obvious that its flow will have to be regulated to insure against low water in winter. This will be accomplished by constructing a storage dam in the river at the mouth of Ruby Creek, ten miles north of Gorge Creek. This dam will be 480 feet high with a 1,100-foot crest at 1,600 feet above sea. It will impound a lake 23

GORGE PLANT
Division point of tunnel to penstocks



SITE OF RUBY DAM
Where the Skagit River will be dammed

miles long, extending a mile beyond the Canadian border, with a capacity of 1,300,000 acre feet.

The dam will require 860,000 cubic yards of concrete; but as it will be built in solid rock at the beginning of the deep and narrow Skagit Gorge, its construction cost is expected to be comparatively low. Above the dam the valley widens out thus making an ideal storage basin. Mr. J. W. Ross, Seattle's superintendent of lighting, estimates that the water stored will be sufficient to insure the minimum flow of 4,547 feet per second for 150 days during the driest seasons.

The work above described will be completed in the near future. But the entire project to develop 600,000 horsepower will require still further construction. From the Ruby Creek storage dam a tunnel three and one-quarter miles long will run to the Ruby Creek power plant just above the mouth of Stetattle Creek. This tunnel will be 28 feet in diameter, carrying 6,000 cubic feet of water at ten feet a second velocity. It will have steel track racks and headgates, six generators, nineteen transformers and switching equipment. The vertical turbines will each generate 55,000 horsepower under a maximum head of 720 feet. The normal head will be 650 feet. As the storage basin is drained off this head may decrease to a minimum of 470 feet.

Twelve years of accurate measurements by the United States Geodetic Survey show the average flow of the Skagit at this point to be 4,557 second feet, while the tunnels are built to carry 6,000 second feet. The reason for this extra capacity is that during the peak hours of morning and evening when the street cars are carrying maximum loads, and the consumption of power for heating and cooking is heavy, the tunnels will run at capacity. But when the demand is less the flow will be diminished commensurately. It is estimated that at 2:00 A.M., 1,500 feet per second will suffice.

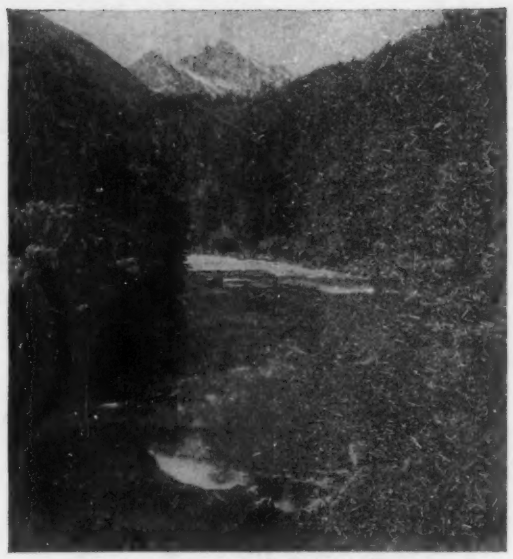
The third and last unit is the Gorge Creek dam to be built at the mouth of Gorge Creek. It will be 240 feet high and will back the water four miles to the base of the Ruby Creek plant, and increase the unit's production to 112,000 horsepower. Owing to the great depth of glacial drift at this point, 112 feet to bedrock, its construction is expected to be relatively more expensive than the one at Ruby Creek where bedrock is found at 20 feet.

A Dream Come True

Power is now being transmitted to Seattle over the 100-mile transmission line at 165,000 volts. The right-of-way condemned by the city is 300 feet wide over which four lines will carry the full production to the distributing stations in the city.

A question that has given rise to much discussion is how to remove the vast stands of heavy timber which cover the entire valley and extend far up the mountain sides. It is all government land, and as the city operates under a government permit, the Federal authorities as well as the city officials have been studying this problem. As a matter of economy the timber must be saved; moreover, the basin must be thoroughly cleared of all floatable debris. It is thought that the plan most feasible is to cut the logs, then build the dam to a certain height and use the lake for transportation to rail. As the timber cutting extends further back the dam will be built higher.

In connection with this development, Superintendent Ross has what he calls his "dream"—a vast plan of color-lighting along Ruby Lake and the Skagit Gorge, having in view making a summer resort of the district. The upper Skagit region is one of the wildest and most magnificent in America. In fact, until the building of the railway to the Gorge plant it was accessible only on foot. But once there one can never forget what he sees. The scenery is of unsurpassed beauty and magnificence. The summer climate is sunshiny and ideal. The grizzly, elk, mountain sheep and goats, and other game are to be found. It is the angler's paradise. It is free of venomous snakes and annoying insects.

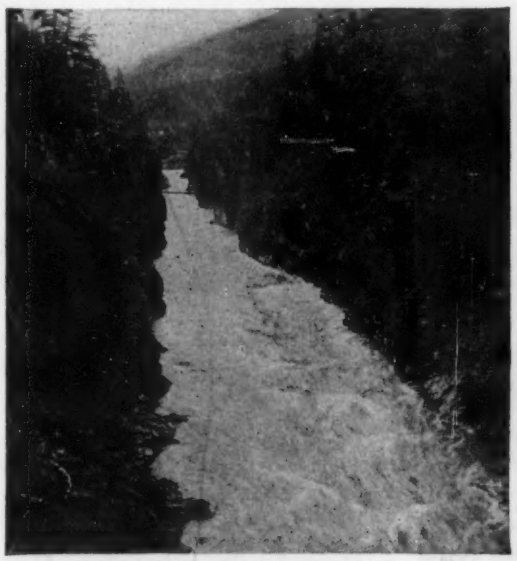


RIVER, FOREST AND MOUNTAIN
Bend of the Skagit River one mile from dam

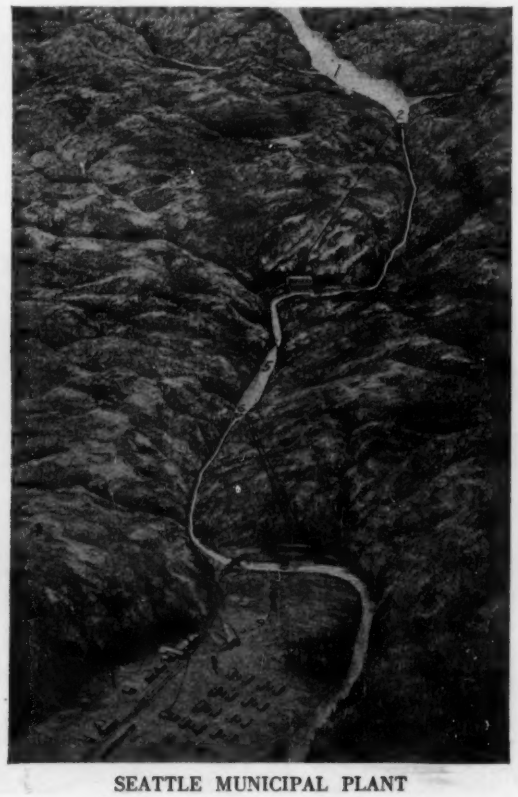
Superintendent Ross reasons that when these magnificent solitudes are accessible, and provision made to care for tourists, the natural attractions will make it a much sought summer resort. Hence, his color-lighting "dream."

Seattle pioneered the development of water power. Its Cedar River plant was one of the first hydro-electric developments in the world; also one of the finest. The city also owns one of the best emergency steam plants in the country, with a capacity of 50,000 horsepower.

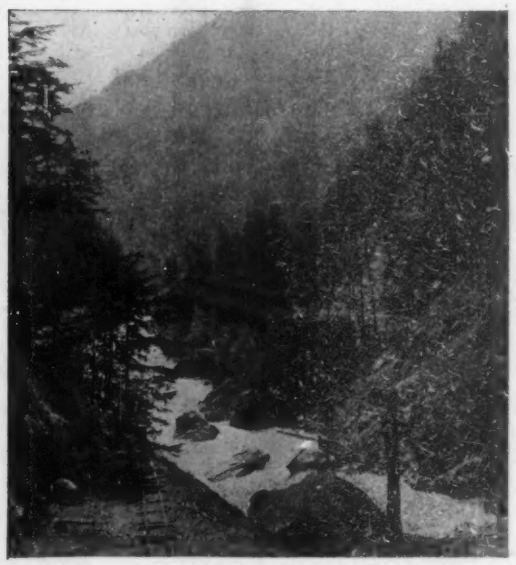
The City Lighting Department is a big institution, serving 80,000 customers with power and light as well as the streets, public buildings and the street railway. Its yearly revenues exceed $3,000,000, though its rates are extremely low and steadily decreasing. The highest rate in Seattle for any purpose is 5.5 cents a kilowatt hour and the lowest one mill a kilowatt hour. Residence rates run from 5.5 cents down to one cent a kilowatt hour. In spite of these low rates, the municipally owned plant since its beginning has turned back to its treasury over $6,000,000 in profit and $4,000,000 in depreciation.



A STRETCH OF THE SKAGIT
Rocky sides favorable to dam building



SEATTLE MUNICIPAL PLANT
Birds'-eye view of power development



AN ANGLER'S PARADISE
A spot well adapted to power development

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

An everlasting label for flowers

Perpetual Label for Flowers

THE old-fashioned method for labeling plants or flowers in large gardens employed a wooden stick with the name written on. In time this becomes blotted out by rains. The new label holder illustrated here seals the name on a piece of paper within a glass tube. Weather conditions never affect it and it can always be seen.

Eliminating the Glare

AN interesting and recent innovation in automobile headlight lenses is shown in the illustration on this page.

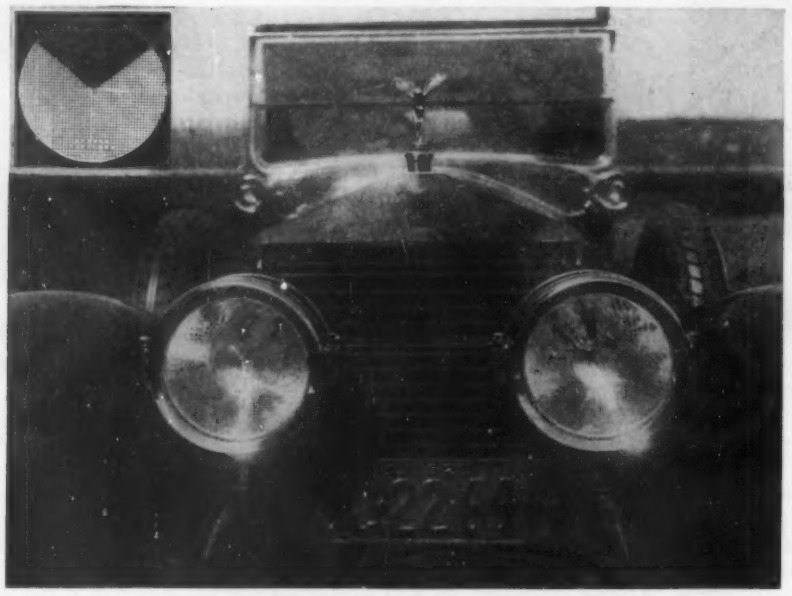
The lens consists of a plain sheet of glass having about three-quarters of its surface, either inner or outer, provided with translucent lines crossing each other at right angles. These translucent lines are produced upon the glass by etching or sandblasting, or in any other suitable manner. The remainder of the lens is clear and transparent. This clear part, which is in the shape of a sector, is disposed at the upper part of the lens, and, contrary to expectation, does not permit an upward diffusion of the undimmed light.

The effect of the construction as described is to cause the headlight to throw a substantially horizontal beam, with very little diminution of the strength of the light.

Old Mill Furnishes Electric Power

ON the Little Chickies Creek, between Columbia and Mount Joy, Pennsylvania, there has stood for years an old-time mill. For many years, farmers for miles around have been accustomed to bring their grain to this flour mill. Today progress has invaded this community and instead of flour being turned out by this old landmark, the waters of the little creek furnish power to run a small hydro-electric plant. Current is furnished to light the homes of about twenty-eight inhabitants.

A low concrete dam was built across this creek which served mostly as a diverting wall to turn the water into the headrace. Very little storage of water is used, but the flow of the stream is sufficient to provide a twenty-four-hour service.



Ma' ing the highway safe

An old mill lights the community and pumps water

A one-man portable pumper, weighing thirty-seven pounds

The pumper in action in a shallow stream

A shell box converted into a seat

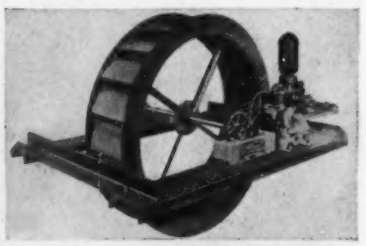
Fire-fighting Machine

THE motor of the fire-fighting machine illustrated here is of a four-cylinder, two-cycle, high-speed type, quick starting and positive in action. The entire weight of motor, pump and base is 70 pounds, making it easy to handle. Connected to the drive shaft of the motor is the geared pump which will pump thirty gallons of water per minute at a pressure of 110 pounds.

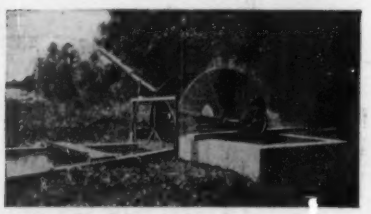
A Shell Box for the Hunter

A MINNESOTA manufacturer has developed a metal shell box which may be used by the hunter for a revolving seat while waiting for ducks or geese to fly or while shooting.

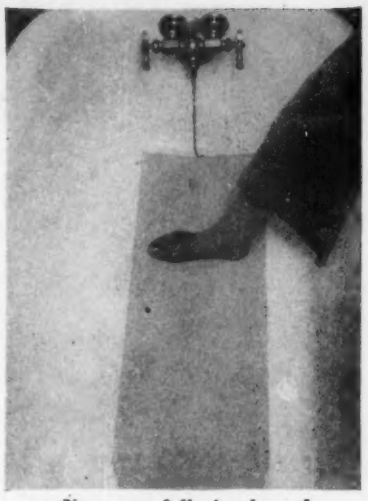
The cover of the shell box is used as the seat and rises automatically with a spring to the desired height.



A modern water wheel that can be erected in an old time mill



A wheel for use on very low falls—say one or two feet



No more falls in the tub

A Smooth Surface for the Slippery Bathtubs

A NEW rubber bathtub mat that prevents accidents by supplying a surface to step upon rather than the slippery surface of the wet porcelain, is illustrated here.

It is made of a soft white rubber with a pebbled surface.

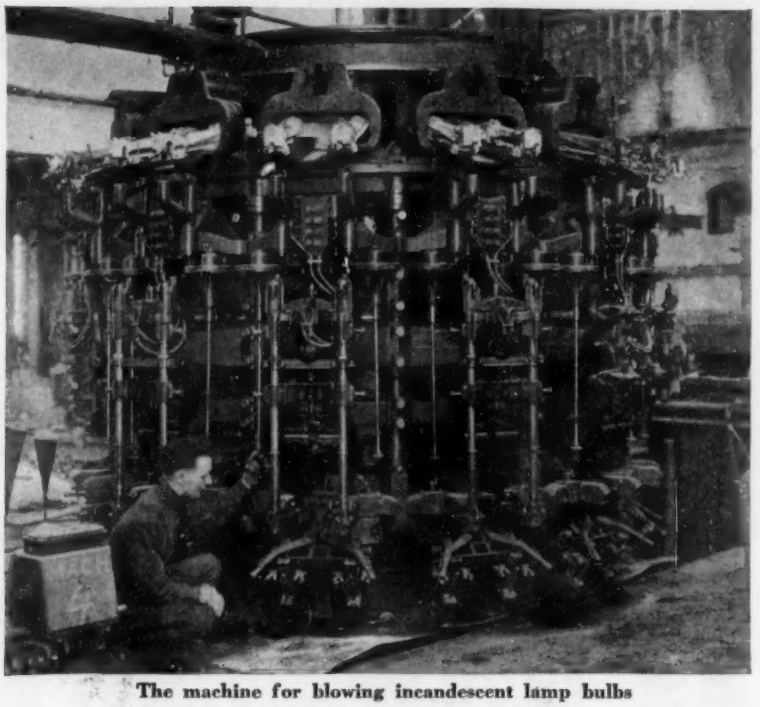
Sterilizes Three Different Ways

INSTRUMENTS may be sterilized by dry heat, boiled, just as in the ordinary water boilers now on the market, and should the water boil dry, a thermostat keeps the heat in check.

In addition to sterilizing instruments by dry heat or boiling, this same sterilizer embodies special facilities for the sterilization of surgical dressings. This is by live steam. After the steaming process they are thoroughly dried out by the circulation of hot air. Dry heat for sterilizing as is used in this electric sterilizer eliminates rust and corrosion.

Blowing Incandescent Lamp Globes Automatically

THIS machine is thoroughly automatic and gathers its glass by the vacuum process. After the blank has been gathered it is transferred to a spindle in which is a small plunger which makes the first indentation in the blank. Puffs of air are then blown into the hole formed by the plunger which expands the molten glass until it is nearly the shape of the mold from which the article is to be blown. These puffs are regulated by cams on a central standard.

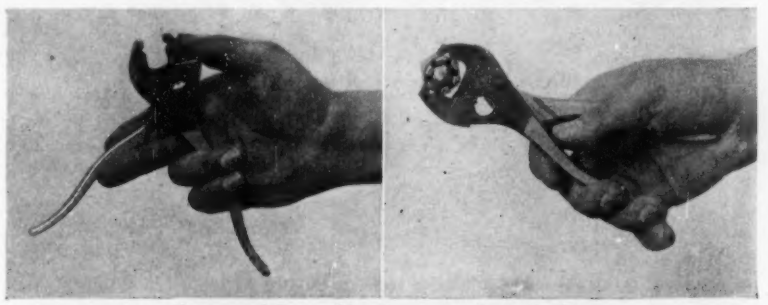


The machine for blowing incandescent lamp bulbs

When the glass is thus prepared the paste or turn mold closes around it and puffs of air are then sent through the spindle at the proper time and the right quantity to expand the blank to the full size of the mold. During this time the spindle is rotating and traveling around the central standard until it comes to the right place, when the mold is opened and the completed article drops on to conveyers which carry it to annealers.

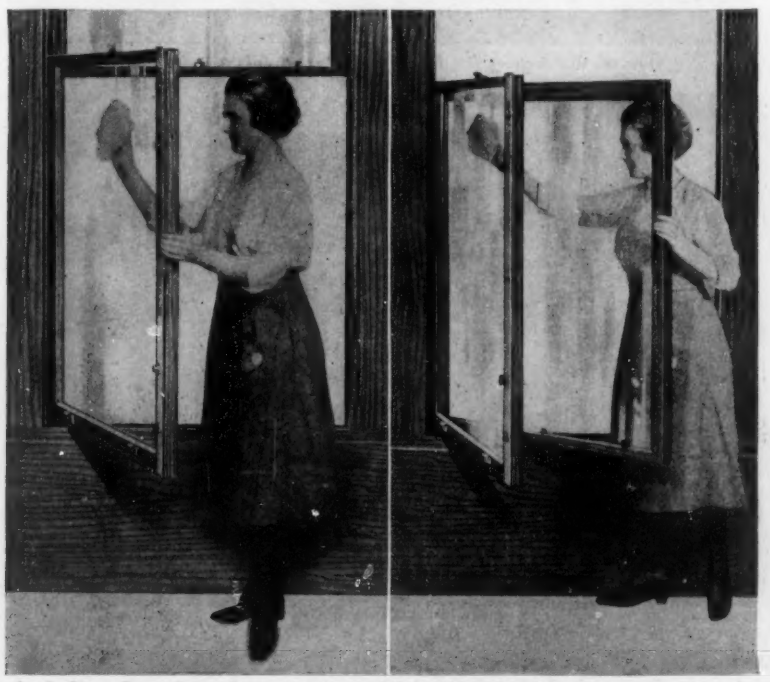
The machine is also adaptable for making light blown tumblers, lamp chimneys, or any article in the paste mold line where quantities are used.

Each machine will blow from 50 to 60 thousand incandescent bulbs per 24 hours with the employment of 12 unskilled persons. In the old way of making bulbs by hand 100 skilled persons were required to produce the same amount of bulbs.



A powerful combination wrench and plier

A sterilizer that works three ways



A window where the sashes swing inwardly making cleaning them a simple task

A safe repository for cigar and cigarette butts

Safety Ash Tray

THE bowl of the safety ash tray illustrated confines the ashes and the remains of the smoke. The tube supporting the top is hollow and permits the debris to fall to the bottom. It can not tip or be knocked over, spilling its contents, as its bottom is so designed that it will spring back into its original position.

"Grip-N-Stick" is Right

ONE of the features of the appliance illustrated is that the jaws are always parallel, and they can be adjusted into four positions to suit the size of nut or other part that is to be gripped.

To change the width of the jaw opening, the levers are opened to the limit, which leaves the movable jaw free to be opened further or closed by means of the thumb. The jaw is then re-engaged by merely closing the levers.

Portable vise post and pipe bender

Automatic stand for electric flat-irons

Automatic Stand for Electric Flat-irons

A STAND, for use in connection with the electric flat-iron, automatically cuts off the current when the iron is placed on it. This stand is connected to the wall-socket, and the iron, in turn, is connected to the stand. A button in the stand is depressed by the weight of the iron placed on the stand, and this automatically breaks the current.

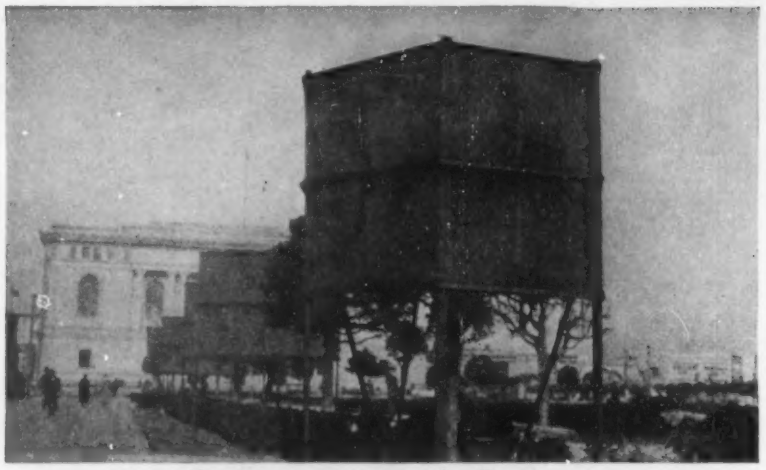
Heavy Winds in San Francisco Make It Necessary to Protect Young Trees in the Civic Center

THE heavy ocean winds in San Francisco in certain seasons have made it necessary to protect the young trees recently set out in the civic center. This protection is provided by means of burlap attached to cleats, the burlap being supported by uprights in such a manner that the wind is deflected from the trees. Otherwise the wind would strike the limbs and foliage and incline the trees to the east.

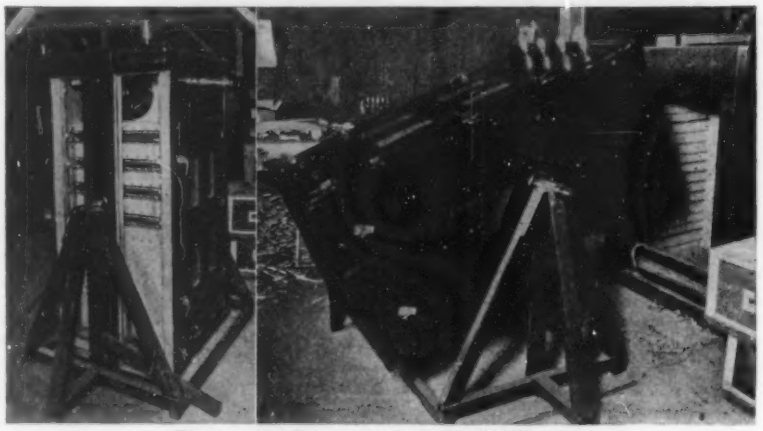
Mammoth Electric Incubator

A NEW electric incubator holds 2,400 eggs and the incubator itself can be turned in a single moment. There are no doors to open, special trays keep the eggs in position, and no cooling of eggs can take place. The incubator has also a special nursery door for the removal of baby chicks. No special wiring is required, as connection is made to an ordinary lamp socket. The dangerous oil lamp has been eliminated as the heat required is furnished by electricity.

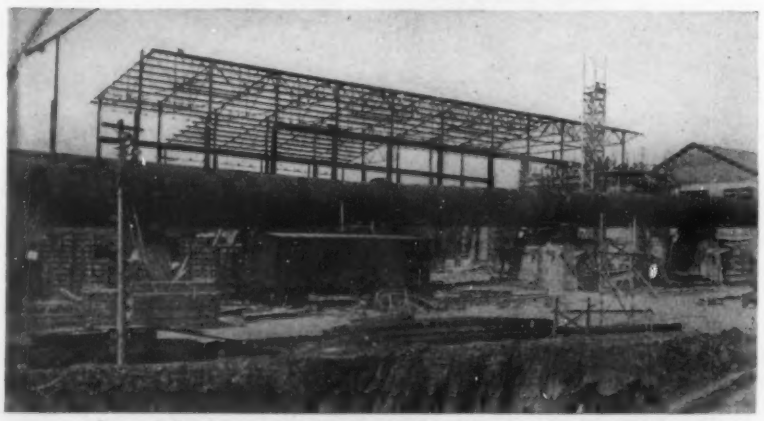
A motor can be supplied for turning the incubator at certain intervals. The machine is equipped with a thermostat, which regulates the heat automatically.



Protecting young trees in San Francisco



Electric incubator which holds 2,400 eggs



One of the largest single pieces of mechanism in the world

Self-adjusting wrench

All Grip—No Slip Wrench

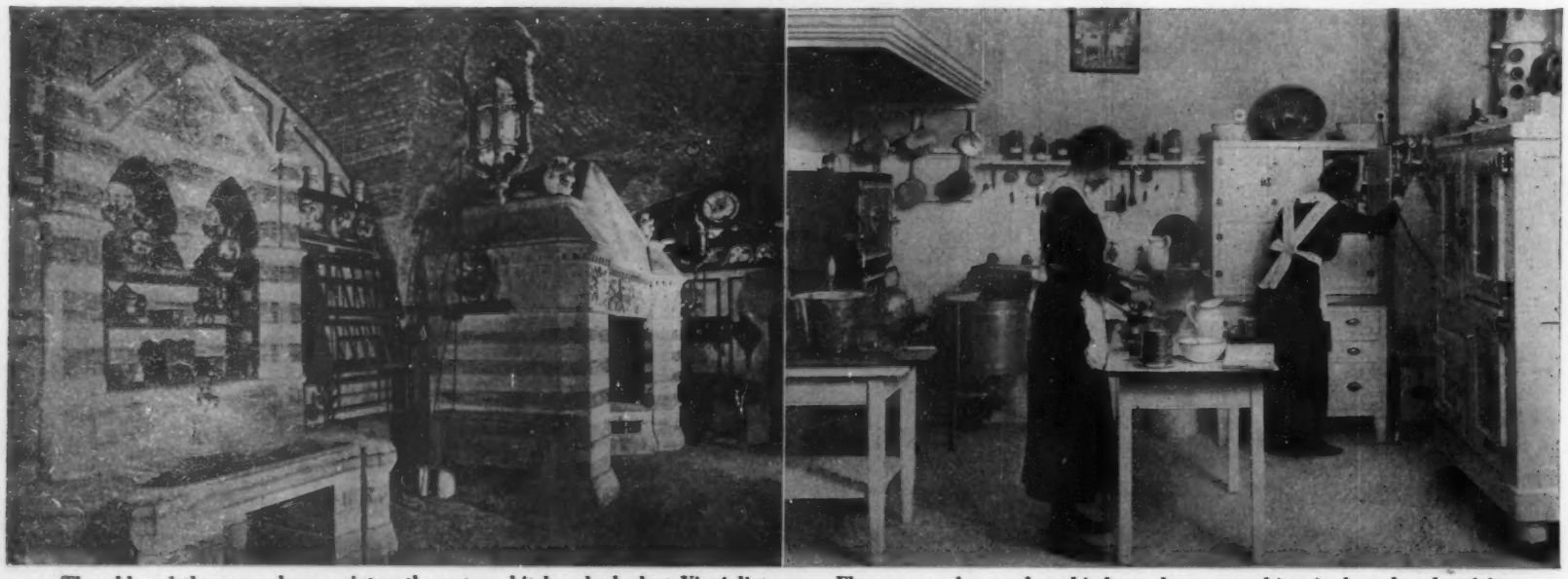
THE wrench illustrated is a self-adjusting, all steel, one-hand pipe wrench in which you will find enormous strength combined with utmost simplicity. The movable jaw is pulled back by hand; a light spring in the handle slides this jaw forward. The jaws, fixed and movable, make a three-point contact with the pipe and pressure on the handle causes a grip which increases with the amount of pressure. To release, simply push the handle forward and the wrench rolls off.

A Huge Cement Kiln

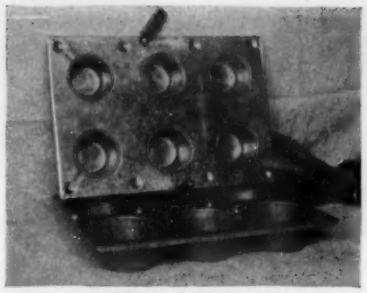
IN the new plant of the Trinity Portland Cement Company at Fort Worth, Texas, a huge kiln 200 feet long has just been constructed. Its immense size is shown by relation to the box car. It is, of course, being mounted so it can be rotated.

A Fourteenth Century Kitchen Compared with One of Today

A FEW miles from Florence is Castello di Vincigliata which dates back to the Fourteenth Century. It came into the hands of an Englishman who restored it in the most elaborate manner and we present a view of the kitchen which is large enough to prepare food for the many inhabitants of the mediaval castle. The great fireplace, which corresponded to the stove is seen on the right. In our other illustration we show a model kitchen of the Twentieth Century.



The old and the new—how a sixteenth century kitchen looked at Vincigliata near Florence, and a modern kitchen where everything is done by electricity



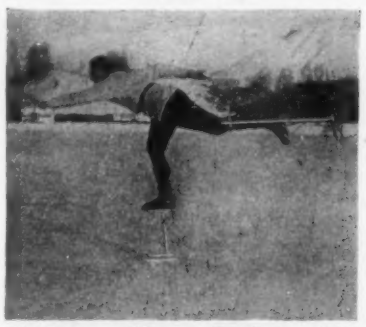
A double-deck cake pan

An Ingenious Cake Pan

WHEN a small muffin is wanted, the top section of the combination cake pan illustrated, is used. When a larger one is wanted, the lower section is used. If the two sections are clamped together and a little dough put in the larger of the two cake pans a variety of cake-cups or molds can be made for holding ice cream, fruit, and so on.

Reflecting Mirror for Railroad Crossing Latest Safety Device

A SAFETY device for railroad crossings to protect the lives of motorists has been placed on a railroad crossing near South San Francisco by the Southern Pacific



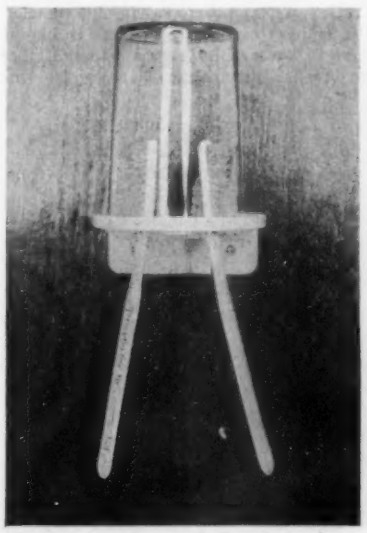
Skating on stilts on the Kulm Rink at St. Moritz

Company. The latest device is a series of four mirrors placed on a blind curve and gives the motorist a clear view of the railroad track.

Our illustration shows the safety mirrors at a railroad crossing. An approaching train can be seen reflected on the right-hand side of the mirror.

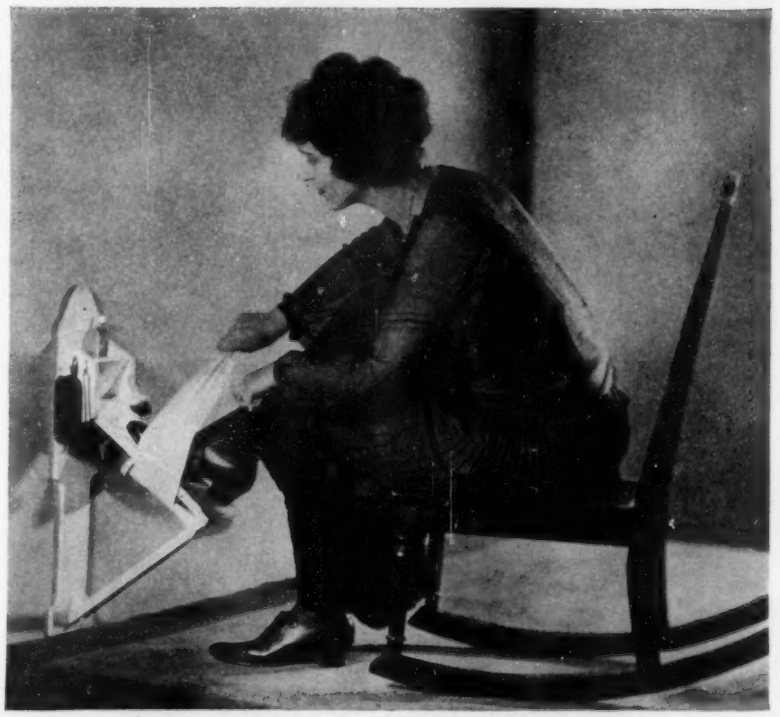
Polish Your Own Shoes

THE shoe polishing device illustrated on this page is a great improvement on the old-fashioned carpet-covered blacking stand for it folds up and is much more efficient. It may be attached anywhere.

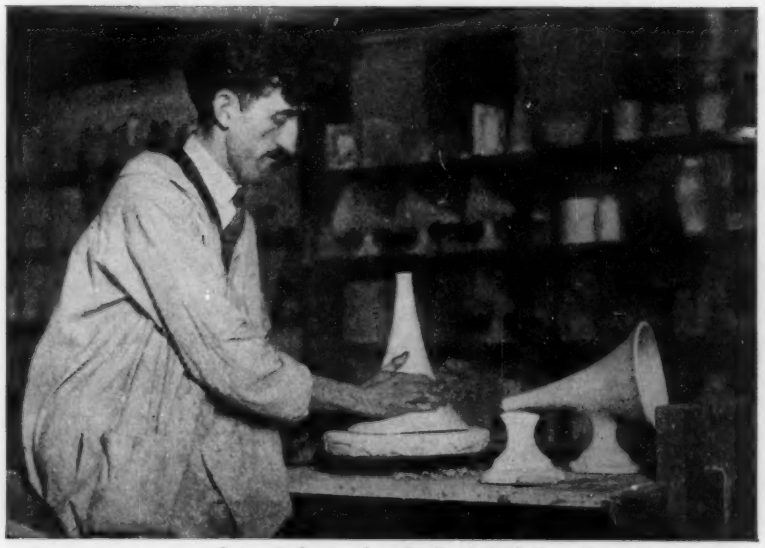


Keeping the tooth brush clean

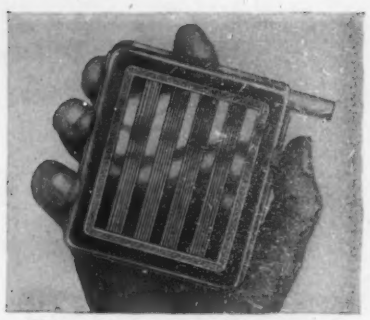
Reflecting mirror for railroad crossing



An improvement on the old-fashioned blacking stand



Ceramic horns for the loudspeaker



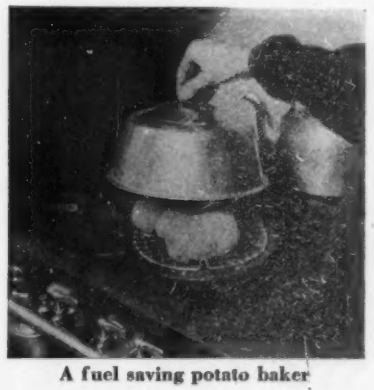
Push the button and out comes the cigarette

The foot rest is covered with rubber. When in use, the foot rest swings out and is adjustable to two heights.

Directly beneath the foot rest are two double-tapered rollers on which the polishing rag (which is unique in itself, being hemmed on all four edges and reinforced by cross strips) runs freely.

Baked Potatoes Without Heating Up the Oven

WE have had two of these excellent devices illustrated here from our local gas company. It takes little gas and less watching. Takes about three quarters to an hour for a small potato.



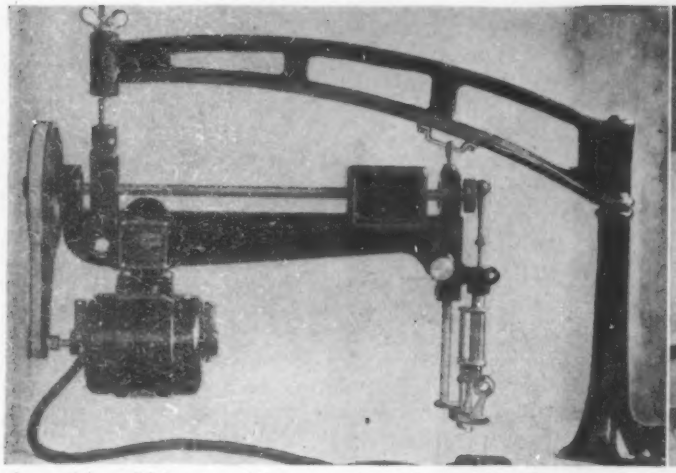
A fuel saving potato baker

New Process for Making Loudspeaker Horns

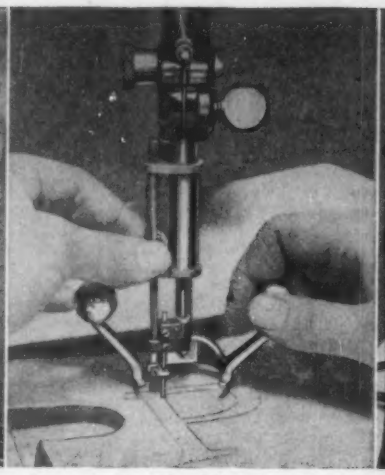
A NEW method of making loudspeaker horns, reproducing music without the usual distortion and at a very low price, has been introduced by William W. Wilkins, teacher of Ceramics at Lewis Institute, Chicago, Ill.

Mr. Wilkins models the speaker out of ordinary pottery clay, and places it in an oven heated to 2,100 degrees, Fahrenheit. It is allowed to remain in this oven for from forty to sixty hours, then taken out and cooled for two days. When cooled, a glazed coating of metallic oxide is sprayed over it, and it is again placed in the oven.

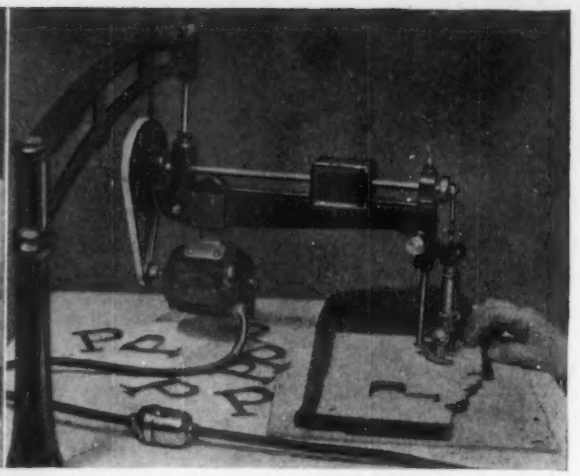
Spraying the glaze



A machine which cuts while you wait.



The middle illustration shows how the cutting chisel is placed on the starting point.



The right-hand illustration shows a number of letters cut at one time and with a smooth edge.

Cutting Difficult Materials

THE machine illustrated is for the cutting of ornamental displays out of wallboard fabrics and many other materials. The cutting is done by a rapidly moving chisel and the cutting mechanism readily follows the motion of the hand in any horizontal direction.

Curves, lines, in fact intricate designs, are cut with a perfectly smooth edge by merely following the outline.

A duck foot universal wheel puller

The material lies flat and is not moved while the machine is cutting, therefore, a panel may be of any length while a circular design is taken out of its center with one continuous stroke.

Wheel Puller for Automobiles

A NEW type of wheel puller, adapted for use on nearly every car, has been designed and manufactured by a Detroit concern. It consists of two parts, a utility three-fingered puller, and a set of plates or nuts to fit different sizes of wheels.

The main advantages of this puller are (1) that it is not breakable on account of having no bell-shaped housing, (2) that the plates are reversible and, therefore, have twice the life, and can be trimmed if threads strip, and (3) the one puller can be used on any wheel for which a plate is furnished, reducing the cost of wheel-puller equipment needed in a garage to a fraction of what it would be if a separate complete puller were required for every size.

Preserving Trees with Cork

THIS new tree filler bends with the tree. It is a natural, durable filling made from cork baked under heavy pressure. It forms a permanent filling said not to injure any tree.

Saving the tree with elastic composition

The new filler is lighter than wood itself, thoroughly flexible and antiseptic. All parts being repaired are firmly cemented to the walls of the filler. It has the very unusual feature of coming in a number of shades harmonizing with the bark itself. Its cost as compared with cement is less.

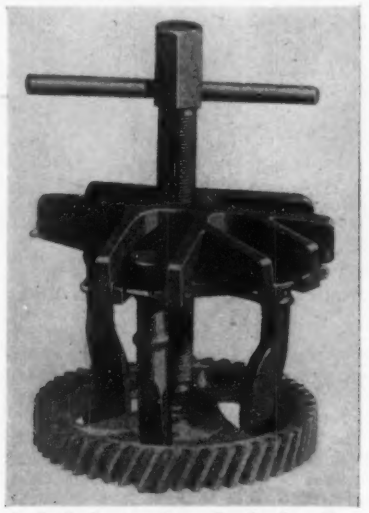
Laboratory Socket and Switch Testing Machine

IN the lower left-hand illustration A is a comptometer for recording number of movements. B, a horizontal arm for operating device under test. C, one of the twelve key lamp sockets being tested.

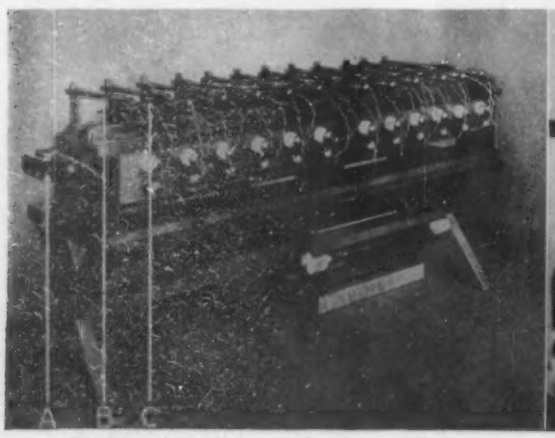
The center cut shows the method of applying the attachment for holding and operating key sockets for testing.

In this illustration A is the socket. B is the attachment for operating key sockets. C is the attachment fitting, to which the slotted arm is clamped. D is the slotted operating arm.

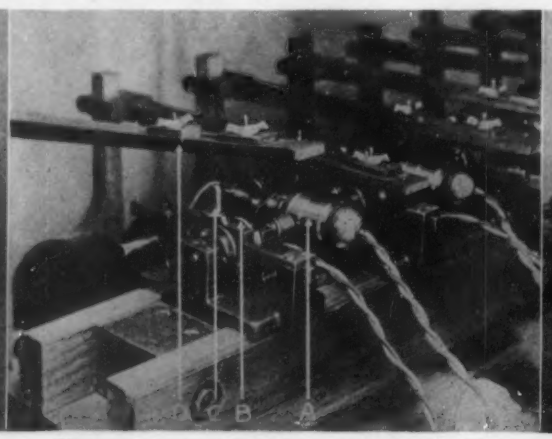
A, B, and C, D, in the right-hand illustration are indicator lamps for respective machines. When defects or trouble develop with any device under test, two of a lower group of white lights go out and the other two become brighter.



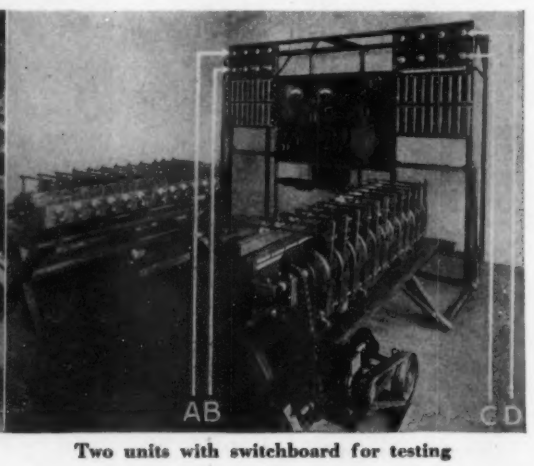
A duck foot universal wheel puller



Machine for testing twelve wiring devices



Close up of one of the lamp sockets under test



Two units with switchboard for testing

Recently Patented Inventions

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SWEATBAND FOR HATS.—Which affords a yieldable and close fitting head receiving opening especially designed for use with straw hats. Patent 1536998. H. E. Aldrich, 69 Wisner Ave., Middletown, N. Y.

Electrical Devices

COIL SUPPORT FOR HIGH-TENSION DEVICES.—Such as are used for the application of electrical rays for body surfaces in the treatment of the skin. Patent 1537012. B. F. Jancke, c/o Halliwell Electric Co., 115 4th Ave., New York, N. Y.

LOOP-ANTENNA-FRAME CONSTRUCTION.—Readily collapsed, easily portable, capable of being packed in a small space, yet durable. Patent 1536997. A. E. Wyatt, 125 Cambridge Ave., Jersey City, N. J.

CONTROLLING SWITCH.—Particularly designed for use in connection with moving electric display or advertising signs. Patent 1536999. F. Z. Barrundia, c/o H. Triest & Co., 35 So. William St., New York, N. Y.

ARC-LIGHT-CONTROL DEVICE.—So regulated as to produce at all times an even, steady illumination. Patent 1537854. S. M. Meyer and W. James, c/o William James, 47 Dinsmore Ave., Brooklyn, N. Y.

SWITCH-POINT ASSEMBLY.—Which can be very quickly mounted on a panelboard, and easily removed for replacement or repair. Patent 1537836. S. M. Lauter, 203 Tompkins Ave., Brooklyn, N. Y.

BATTERY TERMINAL.—Which is easily applied and results in a very firm and secure contact between the terminal and post. Patent 1538129. T. C. Masters, 90 Bleecker St., Newark, N. J.

ELECTRIC-MOTOR-DRIVEN COMPRESSOR.—Designed more especially for garage compressors for storing air for tire inflation. Patent 1538754. G. J. Spohrer, 46 Eppert St., E. Orange, N. J.

ELECTRICAL CONNECTION AND METHOD OF MAKING THE SAME.—Whereby a firm, strong and efficient connection can be made in a short time and with a minimum of labor. Patent 1539723. C. A. Deuscher, 223 St. Anns Ave., Bronx, N. Y.

SAFETY FUSE GRIP.—For removing and replacing cartridge fuses from fuse blocks, or handling other live electrical appliances. Patent 1539302. R. E. L. Curtis, 4212 Eastern Ave., Seattle, Wash.

ATTACHING BRACKET FOR LIGHTING FIXTURES.—Which when attached does not occupy any space in the junction box leaving ample room for connecting wires. Patent 1537780. J. L. Oefinger, 4260½ So. Figueroa, Los Angeles, Calif.

Of Interest to Farmers

CROP DUSTER.—Pneumatically operated for distributing insecticide in powdered form, and adapted for personal wear by the operator. Patent 1537014. E. Knapp and C. G. Allgrunn, c/o Niagara Sprayer Co., Middleport, N. Y.

INSECT EXTERMINATOR.—Especially adapted and designed for use in checking and exterminating boll weevil. Patent 1537570. D. H. Woodward and J. S. Chambers, 1319 Altanta Trust Co. Bldg., Atlanta, Ga.

DUSTING MACHINE.—Which will effectively apply insecticide and fungicides in powdered form by blowing the same downward upon growing crops. Patent 1538779. C. G. Allgrunn and E. Knapp, c/o Niagara Sprayer Co., Middleport, N. Y.

SURFACING ATTACHMENT FOR CULTIVATORS.—Substituted for the cultivating shovels, after they have been employed, for effectively leveling the ground. Patent 1538724. H. H. Mills, Maynard, Minn.

GATE.—Adapted to be raised or lowered bodily to allow of passage therebeneath when desired. Patent 1539708. M. Whiteford, Manito, Ill.

News for Inventors

A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights

Conducted by Milton Wright

New Russian Patent Law

SOVIET RUSSIA has a new patent law. With the country in sore need of industrial development and with elaborate plans on the part of the authorities for exploiting the natural resources, American inventions are bound to play an important part.

Here are some of the features of the new Russian law.

Patents run for fifteen years.

Patents will be issued on inventions which may be used industrially; chemical products are excluded, although patents are issued for new methods of making such products; the patenting for the process covers the product contained.

An invention is not considered new if at the time of its application, either in Russia or elsewhere, it has been so described in a printed publication or in a specification that the principles of using it are made known to others.

Inventions made by a group of persons in any undertaking may be patented as "establishment inventions."

Foreign citizens have the same rights for obtaining patents as citizens of Russia, but a representative in Russia must be appointed.

Work must be effected within five years from the date of grant, lacking which licenses are granted on application, the amount of remuneration to be determined by the court.

Patents or applications in force on November 7, 1917, which have not yet been acknowledged by the Soviet authorities, may form the basis of the issue of new patents on certain conditions.

Slot Machine Profits

INVENTORS often find greater profit in marketing the product of their invention rather than in selling the patent or leasing it on a royalty basis. About a year ago, for example, Claude Parker filed an application for a patent on a machine which would drop out a lead pencil every time one put in a nickel. Without waiting for his patent to issue he began letting out territorial licenses and selling his machines for $25.00 each, the licensee promising to buy from the inventor all pencils used. In eleven months his assets have increased from nothing at all to $65,000.

A more spectacular case is that of Elmer B. Jeffries. His invention was a machine for vending sandwiches, pie and pastry. His circumstances were so straitened that he had the greatest difficulty in trying to raise the small fee necessary to file his patent application. Fortunately, however, Jeffries met some men in Los Angeles whom he interested in the invention and who helped him form a company to exploit it. This corporation is now said to have nearly a half million dollars to its credit, and automatic service stations are springing up like an epidemic all over the Pacific Coast.

Patent Commissioner Thomas E. Robertson with a few of the 155,000 patent models disposed of by the government

Inventors and the Courts

TWO radio patent lawsuits occurring about the same time last spring have left patent authorities still wondering if some changes in the law should not be made in order that an American government employe may be accorded the same protection as a foreigner.

Litigation resulted in establishing the rights of Dr. Marius A. Latour, French scientist, to eighty-two radio patents, and American radio manufacturers made generous settlement with him. Major General George O. Squier, on the other hand, lost his action against the American Telephone and Telegraph Company for royalties on his important "wired wireless" principle upon which modern multiplex telephony is based. The court ruled against him on the sole ground that as an army officer he "dedicated his invention to the public."

Of General Interest

REFRIGERATING ARRANGEMENT FOR DRINKS AND FOOD.—And more particularly adapted for use in connection with cooling liquid in bottles. Patent 1532982. A. Blom, Stockholm, Skeppargatan 14, Sweden.

WINDOW CONSTRUCTION.—In which sections of the sashes may be removed to permit cleaning the window from within. Patent 1532916. A. L. Mason, 342½ Water St., Meadville, Pa.

LIFTING DEVICE.—Comprising lifting bars and adjustable chains and grab-hooks, for engaging on boxes, crates, barrels, blocks of ice, etc. Patent 1533001. C. Haarberg, R. F. D. Box 57, Kent, Wash.

GUY COUPLER FOR MASTS.—Wherein bolt receiving flanges are provided around the coupler, for permitting different locations for the guy members. Patent 1533019. A. Link and L. W. Link, c/o Albert Link, 483 8th St., Brooklyn, N. Y.

TOY CONSTRUCTION.—Including a set of selectively engageable units for the purpose of building up structural combinations. Patent 1533011. R. S. Knaggs, 406 W. 31st St., New York, N. Y.

PRICE-TICKET HOLDER.—Of light material, but of rigid construction, with securing means for keeping the holder in place. Patent 1533005. H. and L. Hopp, 132 W. 14th St., New York, N. Y.

PROCESS FOR THE DIRECT COOLING OF GOODS.—And avoiding the entrance of foreign substances, especially salt, into the goods. Patent 1532931. A. J. A. Ottesen, c/o J. Preisz, Axelborg, Copenhagen, B., Denmark.

GAS PRODUCER.—For gasifying shale, employing a novel means for effectively applying combustion—supporting gaseous fluids and steam to fuel on a grate. Patent 1532,179. J. B. Goodwin, Harbor Hotel, San Francisco, Calif.

BASKET.—For containing artichokes or fruits with delicate skins, providing free circulation of air and preventing damage to the fruit. Patent 1532298. D. Bloom, 85 2nd St., San Francisco, Calif.

SHOE LACE.—Which after being applied will permit the shoe to be removed from the foot without untying the lace. Patent 1533,964. M. Berman, 551 W. 186th St., New York, N. Y.

CHILD'S HAND BAG.—Serving the double purpose of a doll and hand bag combined. Patent 1533428. Caroline T. Kittleson, 420 Fullerton Ave., Chicago, Ill.

CLOTHESRACK.—Comprising a plurality of collapsible bars, with means for pivotally securing them together, and locking them. Patent 1533470. O. G. Schmitt, The Belden-Stratford Hotel, 2300 Lincoln Park W., Chicago, Ill.

QUILTED WATERPROOF PAD.—Which is very flexible, and may be used as a cover for mattresses, beds or tables. Patent 1533,973. S. Cohen and S. Kilberg, c/o Samuel Cohen, 543 Crown St., Brooklyn, N. Y.

SHRINKPROOF STUD SUPPORT.—For allowing the upper series of studdings to remain unaffected by shrinking and preventing the building settling. Patent 1532729. G. E. Carlson, 268 Vine St., San Jose, Calif.

METHOD OF PRODUCING FORMS.—Whereby articles or ornaments of thin wall or shell structure may be readily formed of any desired shape. Patent 1532325. G. Y. Lee, 656 Grant Ave., San Francisco, Calif.

FLUSH VALVE.—Adapted for toilet flush tanks, easily adjusted for centralizing over the flush pipe, and readily renewable. Patent 1532324. H. G. Lawrence, 1150 East 3rd South St., Salt Lake City, Utah.

MAIL-BOX SUPPORT.—Particularly intended for supporting mail boxes along rural routes of strong and durable construction. Patent 1533887. C. M. Mugler, Clay Center, Kansas.

FLUSH TANK.—Which includes automatic means for controlling the flow of water, and insuring a predetermined quantity within the tank. Patent 1533884. C. M. Minton, Philomath, Oregon.

ADJUSTABLE WELL CASING AND SAND SCREEN.—That will function well in sand and gravel strata providing a larger seepage area and water supply. Patent 1533747. W. D. Lough, Scott City, Kans.

SNAP.—For wrist watch bands, wherein the material of the band is not pierced, and may be quickly adjusted. Patent 1534944. F. G. Haage, 37 Hilton St., Clifton, N. J.

WINDOW-CLEANER'S SEAT.—Which can be securely anchored to a window sill in position to permit a person safely sitting thereon. Patent 1534895. J. A. Blackwood, 120 Bostwick Ave., Jersey City, N. J.

BRIDGE PIECE.—To take the place of the ordinary wooden bridging, in connection with floor joists, studding and other building structures. Patent 1535043. S. Scanlon, 428 E. 153rd St., New York, N. Y.

MASSAGE DEVICE.—Having means for lowering the internal temperature of such device, without the use of ice. Patent 1534,974. J. O. Linden, Loderup, Kristianstade, Sweden.

MILK-BOTTLE SUPPORT AND LOCK.—Which will present a desirable support, and automatically lock the bottle against unauthorized removal. Patent 1534912. C. Bruderlein, 307 E. 77th St., New York, N. Y.

BRIQUETTE OF CHARCOAL AND PITCOAL.—For the rapid lighting of furnaces, ovens, stoves, fireboxes, etc. Patent 1534962. E. Josue, c/o Barzano & Zanardo, 9 Via Duc Marcelli, Rome, Italy.

WATERPROOF SHOE FOR USE IN COUNTER CONSTRUCTION.—For supporting the base of marble counters, such as are usually provided at soda fountains. Patent 1534925. J. K. Demeter, 98 Broadway, Astoria, N. Y.

ANIMAL TOY.—Particularly adapted for cats, wherein a ball is presented containing an artificial mouse, which may be seen but not removed. Patent 1534964. S. B. Kahnweiler, 3529 Pacific Ave., Atlantic City, N. J.

PRESSURE REDUCING VALVE.—For steam or water pressure regulation, so constructed as to permit of ready access to the interior and adjustment. Patent 1534899. J. E. Boggiano, 36 W. 71st St., New York, N. Y.

CHECK PROTECTOR.—Relating to an attachment for inking the finger before making a finger print on a check, and cleaning the finger after operation. Patent 1536991. A. Varetoni, 48 Van Ripen Ave., Clifton, N. J.

WATER METER BOX.—Having a removable cover with tool receiving opening, whereby the cap may be easily removed. Patent 1537008. N. Forni, 1377 62nd St., Oakland, Calif.

COLLAPSIBLE TUBE.—Adapted for dispensing icing for cakes in any desired form or shape. Patent 1537010. F. Herscmann, 128 Sherman Ave., Inwood Station, New York, N. Y.

PILE FABRIC.—For rugs and other articles, using comparatively short piling firmly held in the desired position. Patent 1536,975. H. Ruegg, Jr., Kingswood, Weehawken, N. J.

SUGAR CONTAINER.—In which sugar can be stored so that the tendency to lump in moist atmosphere will be eliminated. Patent 1528927. J. Kaplan, 380 Thames St., Newport, R. I.

RETAINING DEVICE FOR FILING CABINETS.—Which facilitates the operation of locking or releasing the files, of cards or other contents. Patent 1537894. F. C. Smith, c/o Florida Citrus Exchange, Tampa, Fla.

CAP FOR RUBBER HEELS.—In the form of a quickly attachable and detachable auxiliary leather heel, for rubber heels. Patent 1537,761. J. Geisman, 27 Spruce St., New York, N. Y.

BLANKET HOLDER AND FIRE EXTINGUISHER.—In the form of a tube for holding fire extinguishing material, or a rail for supporting articles in an automobile. Patent 1537,887. G. C. Savage, Glastonbury, Conn.

FLASHING PLUG.—Capable of being easily secured in position to retain a flashing in place. Patent 1537826. C. O. Johanson, c/o Harry F. Bryant, Knox-Carbett Lumber & Hardware Co., Tucson, Arizona.

CAMPER'S TABLE.—Which can be completely taken apart and stored in a small space. Patent 1538393. M. M. Fowler, 84 Gibbs St., Portland, Ore.

SPECIFIC GRAVITY TESTER.—Having means for guiding the hydrometer in such a manner as to reduce friction to a minimum. Patent 1537888. O. O. R. Schwidetzky, c/o Becton-Dickinson & Co., Rutherford, N. J.

MOLD FOR FORMING STEPS.—Which may be readily placed in operative position for forming concrete steps of any length. Patent 1538604. C. A. Thrasher and C. R. Owen, 36 Roxbury St., Worcester, Mass.

PAD FOR CHILDREN'S CHAIRS.—Serving both as a cushion, and a securing means to prevent the child from falling. Patent 1538,538. M. E. Wood, 2600 Washington Ave., Ogden, Utah.

FISHING REEL.—Movable longitudinally of the rod, and permitting a line to be quickly wound, by the pressure of a lever. Patent 1538377. J. D. Blagden, 2146 Cowden, Ave., Memphis, Tenn.

Hardware and Tools

CUTTING IMPLEMENT.—Adapted for stationary attachment, leaving the user's hands free to handle the article to be cut. Patent 1531160. J. Toomey, Riverside, Conn.

PLANTING TOOL.—For molding the tilled soil to receive bulbs, etc., or to receive fertilizers, water, or plant nutriment. Patent 1531100. J. M. Howard, R. F. D. No. 3, Media, Pa.

SAFETY RAZOR.—In which the blade holder can be rotated, and the blade reversed to present a fresh cutting edge. Patent 1531071. V. Cabella, Guatemala, Central America.

SAW HANDLE.—Including means for securely attaching the same to a saw blade, without forming new openings therein. Patent 1531131. W. G. Price, Box 16, R. F. D. No. 1, Ashland, Pa.

MEADOW-DITCHING TOOL.—Which is operable by one man in forming ditches or trenches in meadow land, in the work of exterminating mosquitoes. Patent 1531161. J. Toomey, Riverside, Conn.

REAMER.—Especially designed for securely holding the blade cutting tools against longitudinal movement. Patent 1530846. F. P. Miller, c/o McCrosky Tool Corp., Meadville, Pa.

WRENCH.—Designed for use in the adjustment of the bands in a transmission arrangement of a Ford car. Patent 1529075. M. McIntyre, 139 Center St., Healdsburg, Calif.

LOCK FOR WINDOW SASH.—Adapted to lock a sash in such position as to permit the ventilation of a room, without permitting unauthorized entry. Patent 1531901. F. D. Clark, 617 Shelby St., Frankfort, Ky.

BOILER PLUG.—For boiler heads, which may be readily attached or removed, but is locked against rotary movement during tightening or loosening. Patent 1531072. J. Cardinal, 13 Huntington St., Brooklyn, N. Y.

CLOTHESLINE SUPPORT.—Constructed of wire, for supporting the lower lead to prevent undue sagging from the weight of clothes. Patent 1531977. W. S. Ritch and S. W. Pidge, c/o Ritch & Pidge Mfg. Co., Fultonville, N. Y.

DEVICE FOR ATTACHING WINDOW SCREENS.—In the form of a strip of metal, bent at right angles to secure the screen against the stop bead. Patent 1531947. D. C. Jamieson and F. Rowett, 294 Belmont Ave., West Kildonan, Manitoba, Canada.

AWNING CONSTRUCTION.—Which will control the operation of an awning from the inside of a window. Patent 1532067. W. F. O'Donnell and C. Seybold, 7647 Lowe Ave., Chicago, Ill.

DOWEL PIN AND MORTISE LOCK.—Comprising a U-shaped anchor with prongs adapted to frictionally engage the pin and then bend outwardly. Patent 1531916. D. J. Flintjer, 3829 Lake Park Ave., Chicago, Ill.

PIPE CUTTER.—In which a multiplicity of cutting wheels may be drawn into exceedingly close engagement with the pipe. Patent 1532315. V. Karbowski, 1402 N. Park Ave., Chicago. Ill.

GARDEN TOOL.—Which facilitates the removal of weeds, without the necessity of stooping over to grasp the weeds during their removal. Patent 1533132. W. J. Neidhart, 116 W. La Salle St., South Bend, Ind.

RAKE.—Having wire tines arranged in fan formation, and the ends downwardly turned. Patent 1532764. H. G. Kimber, 1633 25th Ave., Oakland, Calif.

CAN-OPENING DEVICE.—Adapted to rapidly and completely sever a can top, exceedingly close to the side walls of the can. Patent 1534932. H. J. Edlund, 49 Bay View St., Burlington, Vt.

RAKE ATTACHMENT.—Which will readily convert a rake into a hoe, by a simple turning movement. Patent 1537005. H. C. Carson, 3831 Olivette Ave., Sta. L, Cincinnati, Ohio.

SOLDERING POT.—Minimizing the danger of accidentally burning parts adjacent a joint, or dropping solder on a floor. Patent 1537002. G. W. Bradley, 6515 Bradley Ave., St. Louis, Mo.

CAN OPENER.—Adapted to cut and remove the cover of any sized can adjacent to the edge in a single operation. Patent 1536053. V. E. Baker, c/o J. H. Lickert, New Haven, Ind.

WINDOW-SASH LOCK.—Which constitutes a means for moving the sash and for retaining it in open or closed position. Patent 1537779. P. J. O'Brien, Bay Bulls, Newfoundland.

JACK.—For lifting heavy paper rolls to or from a printing press. Patent 1538397. F. H. Goodrich, c/o J. B. Lewis, Lewis Block, Greenville, Mich.

SWIVEL CONNECTION.—For connecting a cable, or choker line, so that the fastening element may rotate about the axis. Patent 1537785. L. E. Parker, Pe Ell, Wash.

PLUMB BOB.—So constructed that the spool carrying the line may be enclosed within the plumb bob when not in use. Patent 1538746. C. P. Reneau, Tunice, Mississippi.

Heating and Lighting

FURNACE ATTACHMENT.—Providing means for collecting and quenching unburned fuel, so that it may be used in the furnace again. Patent 1531126. J. D. O'Brien, 248 Newkirk Ave., Brooklyn, N. Y.

SEDIMENT SCRAPER FOR WATER HEATERS.—By means of which the discharge of sediment and settlings may be readily effected. Patent 1531348. A. Richardson, 49 Myers St., Nelsonville, Ohio.

LIQUID FUEL HEATER.—Thoroughly gasifying the fuel oil used in connection with steam, hot water, or hot air furnaces. Patent 1532042. R. L. Condra, 128 Lariami St., San Antonio, Texas.

PRESSURE-COOKER ATTACHMENT.—Constituting also a water heater which has the further feature that the water in the heater may be used as a shower bath. Patent 1532,945. H. Quigle, Whittier, Calif.

WATER HEATER.—Wherein an electric heating element is arranged interiorly of the tank, so that the heating element is substantially surrounded by water. Patent 1534898. L. L. Bluemlein, Box 51, Station Y, New York, N. Y.

STAND BOILER AND WATER HEATER.—In which the water may be rapidly heated, the water heating chamber being insulated from water of a lower temperature. Patent 1536,989. A. H. Trageser and L. Hassinger, 447 W. 26th St., New York, N. Y.

SAFETY VALVE FOR GAS JETS AND THE LIKE.—Which serves to automatically shut off the supply of gas, upon a hose being severed from a jet. Patent 1537001. H. Benvie, 999 Broad St., Meriden, Conn.

WATER-HEATING SYSTEM.—Having particular reference to a heating system for use in connection with washing machines. Patent 1537842. C. A. McCarty and W. A. H. Jones, c/o Charles A. McCarty, 6 Allerton St., Plymouth, Mass.

AIR PREHEATER.—Which functions to utilize the smoke and gases from a furnace or stove, to preheat air entering the same. Patent 1538866. W. T. Chamberlain, 56 W. 91st St., New York, N. Y.

Machines and Mechanical Devices

APPARATUS FOR AMALGAMATING.—Gold and other precious metals in passing over a sluice box, in placer mining. Patent 1529,038. A. Root, 869 Fulton St., San Francisco, Calif.

TANK CLEANING DEVICE.—Capable of being operated by any ordinary workman from outside a tank, for removing any residual material therein. Patent 1530659. J. W. Force, Box 51, South Bend, Texas.

HOISTING APPARATUS.—Which is portable, and particularly adapted for handling sacks of flour or grain in a warehouse. Patent 1529939. A. C. Whittemore and B. B. Burnett, Lompoc, Calif.

MACHINE FOR THE PURPOSE OF CHANGING THE FEET ON WATCH DIALS.—By the use of which a watch dial can be transferred from one watch to another and accurately positioned. Patent 1531092. O. Handler, 1699 Washington Ave., New York, N. Y.

SEPARATOR.—Which will automatically separate water from oil, and is also adapted for separating other fluids. Patent 1530836. A. W. Kuzilik, Box 494, Barnsdale, Okla.

WEED DRIFTER.—Adapted to be positioned in a ditch, or other water way, to collect weeds at desirable points and prevent clogging. Patent 1530551. E. W. Fry, c/o Theo. Torbenson, Bank of Commerce, Kalispell, Mont.

MECHANISM FOR RAISING AND LOWERING AWNINGS OR FLAPS.—For windows, doors, sides of buildings, etc., by means of a spiral screw and operating lever. Patent 1531051. W. A. Tomlinson, 1217 W. Jefferson St., Phoenix, Ariz.

CANDY SPINNING AND WEAVING MACHINE.—For quickly producing candy of a fine quality from a prepared batch of syrup. Patent 1532031. T. Bosshard, St. Albans, Queens Co., L. I., N. Y.

NOZZLE FOR WASHING MACHINES.—Which is very efficient in breaking up or spraying water in connection with a dish washing machine. Patent 1531958. L. T. Lathrop, 13th Inft., Fort Revere, Hull, Mass.

TRANSMISSION MECHANISM.—Having means for positively locking the keys against movement when they operatively engage with their respective gears. Patent 1532102. G. C. File, South Oak St., Buchanan, Mich.

SHEAR GUIDE.—A device which insures straight cutting of a piece of cloth or the like by a pair of shears. Patent 1532019. H. Zimmerman, 876 Huntspoint Ave., Bronx, N. Y.

MACHINE FOR MAKING BUSHEL-BASKET MATS.—And accurately forming or braiding the mats of which the baskets are subsequently made. Patent 1531355. O. E. St. John, Box 305, Gloversville, N. Y.

ROTARY DRILL.—Adapted for general boring purposes, and designed particularly for reducing labor in drilling oil wells. Patent 1530803. W. A. Anderson, c/o Red Mountain Ranch, Fallbrook, Calif.

CUTTING MEANS FOR MOWING MACHINES.—Which will equalize the cutting resistance throughout the cutting stroke, give a lighter draft and longer life to the machine. Patent 1533035. J. W. Shanbeck, 1330 Jackson St., Ft. Wayne, Ind.

TOOL TRIMMING MACHINE.—Especially adapted for use in the truing of toric tools on which toric spectacle lenses are ground. Patent 1532959. J. W. Taylor, 530 Broad St., Gadsden, Ala.

ICE-SCORING MACHINE.—Producing a horizontal cut and vertical cuts upon opposite faces of a block of iee. Patent 1533056. J. S. Yager and L. Starling, c/o Consumers Ice Co., Greenville, Miss.

VENTILATING DEVICE.—For use primarily in connection with theatre ventilation, the device being positioned under the seats. Patent 1532505. De W. T. Lyon, Buena Plaza Aptmts., 4353 Kenmore Ave., Chicago, Ill.

THREADED BLOCK.—Automatically guiding the thread into correct threaded position, and automatically varying the tension. Patent 1533036. J. M. and P. J. Shannon, 182 Broad St., Norwich, Conn.

ROLLING MILL.—In which bar, rod, or partly finished blank, may be converted into a plurality of united rails ready for cutting. Patent 1533026. G. J. Murphy, Baradero, F. C. C. A., Buenos Aires, Argentina, S. A.

MACHINE FOR MAKING DOVETAIL SLOTS.—In laths, which are formed by a matching or molding machine. Patent 1532467. J. R. Barnett, Illinois Lumber Yards, Cairo, Ill.

ENDLESS SICKLE BLADE.—Composed of a series of linked blades connected in an endless belt, and supported to move in one direction. Patent 1532279. H. Ullom, Lamar, Colo.

TENSION DEVICE FOR SHUTTLES.—Which is so constructed as to facilitate the threading thereof. Patent 1533037. P. Shannon, 182 Broad St., Norwich, Conn.

PIPE BENDING MACHINE.—Which will uniformly and evenly bend cold pipe of various sizes. Patent 1533443. A. Miller, 4849 Washington Ave., Newport News, Va.

ROCK CRUSHER.—Of centrifugal construction, having a rotor adapted to receive the rock centrally and discharge it peripherally.

Patent 1532742. A. D. Hadsel, 500 Call Building, San Francisco, Calif.

COTTON-CLEANING MACHINE. — Whereby "cotton locks" and "cotton linters" may be reclaimed from cotton seed, and entirely free from all foreign matter. Patent 1533593. V. D. Harlan, Humphrey, Arkansas.

CASING-HEAD LATCH.—Which will instantly cut off the flow of oil in a well, thereby reducing fire hazard, and oil loss to a minimum. Patent 1533875. C. McCleary, Box 264, Webb City, Oklahama.

FLEXIBLE COUPLING.—That allows of longitudinal and tilting motion of one shaft relative to the other, so that the shafts may be axially disalined. Patent 1532743. A. D. Hadsel, 500 Call Building, San Francisco, Calif.

EVAPORATOR.—For drying fruit, in which the air current can be regulated to pass over the fruit in different directions. Patent 1532303. W. W. Cozzens, Box 529, San Jose, Calif.

ADJUSTABLE AUTOMATIC VALVE REGULATOR.—Providing mechanism in a pipe line for manually opening and mechanically reseating a valve. Patent 1533407. L. H. Hanson, c/o L. L. Hoge, Austin, Texas.

MIXING PROCESS AND APPARATUS THEREFOR.—By means of which a cementitious mixture will be of even quality and uniform strength throughout. Patent 1533950. V. H. Schlich, 136 Liberty St., New York, N. Y.

BELT LENGTH CALCULATOR.—That may be easily operated to discover the length of belt required to give the desired tension. Patent 1533981. G. R. Fickert, 611 Bloomfield St., Hoboken, N. J.

DEVICE FOR DEMONSTRATING ANGULAR MOMENTUM. — For demonstrating physical laws, more particularly for exhibiting the conservation of the energy of rotation. Patent 1533500. O. Hovda, Evansville College, Evansville, Ind.

SCRAPER.—Primarily designed to be drawn by a tractor and used on road construction or the like. Patent 1533720. P. C. Anderson, 519 So. 27th St., Lincoln, Neb.

PISTON.—For use in connection with a force pump, to prevent a pressure medium actuating the piston from leaking past the piston. Patent 1532293. A. L. Armentrout, Whittier, Calif.

ASSEMBLING AND COUNTING MECHANISM. —For automatically counting, reversing and packing in alternate position, match books, which are thinner at one end than the other. Patent 1535031. T. A. Nevins, 120 Liberty St., New York, N. Y.

ELEVATOR SAFETY APPLIANCE.—Providing a manually controlled means operable from an elevator car, for bringing the safety control means into action. Patent 1534291. D. A. MacAskill, Box 18, Station V, Brooklyn, N. Y.

DITCHING AND GRADING MACHINE.—With various simple operative elements, which by rearrangement, will dig and clean ditches, fill ditches, or level rough ground. Patent 1534900. C. F. Bolin, Box 61, Parkman, Wyo.

NEEDLE-OPERATING MECHANISM FOR KNITTING MACHINES.—Having an arrangement of locks suitable for use in producing both plain and fancy work, without an extra needle. Patent 1534972. A. Leviton and W. Kaplan, c/o Radio Sports Wear Co., 156 Broadway, Brooklyn, N. Y.

METAL BINDING MACHINE.—For attaching metallic binding elements to the corners or edges of articles such as pocket books. Patent 1535068. M. A. Wachs, 33 Bleecker St., New York, N. Y.

RUBBER-TUBE-CUTTING MACHINE. — For cutting rubber tubes in transverse sections for the purpose of making rubber bands. Patent 1533126. C. B. Martin, 1129 Sixth St., N. W., Canton, Ohio.

PEBBLE MILL.—Composed of a plurality of sections readily assembled, the usual driving gears and ring gears being eliminated. Patent 1536491. C. J. Guderoth, Box 750, Bonne Terre, Mo.

TENSION REGULATOR FOR SECTION BEAMS ON SLASHER AND BEAMER CREELS.—Which maintains a constant and uniform tension on each sheet of yarn as it is unwound from its beam. Patent 1536047. W. W. Arnold, Jr., c/o Manchester Cotton Mills, Manchester, Ga.

PLUSH-LOOM-CUTTER STOP.—So arranged that when the mechanism for moving the cutter fails to operate the machine will be automatically stopped. Patent 1537000. W. Bellmar, c/o Astoria Silk Works, 727 Steinway Ave., Long Island City, N. Y.

CALCULATING MACHINE.—In which the multiplication and subtraction are secured through the use of a moving lever and selected fulcrums therefor. Patent 1527407. G. F. Harmsen, Arequipa, Ap. 17, Arequipa, Peru.

GLOVE-FINGER-SUPPORTING DEVICE. — For holding the glove, insuring accuracy in the placing of the glove finger and turning the same. Patent 1537794. D. Baum, c/o Livermore Falls Glove Co., Livermore Falls, Maine.

CAN OPENER.—Which affords facilities for rotating a can in contact with a cutting blade for cutting the top. Patent 1537110. H. J. Edlund, 49 Bay View St., Burlington, Vt.

SEALING MACHINE.—Adapted to automatically seal booklets, leaflets, or the like one at a time as they pass through the machine. Patent 1538747. D. R. Robinson, 3144 W. 47th St., Chicago, Ill.

PISTON RING.—Affording a double seal on both the cylinder walls and the follower plates thereby effecting economy. Patent 1538758. C. H. Taylor, Biloxi, Mississippi.

Medical Devices

SURGICAL KNIFE.—Having a removable blade which the operator may easily and quickly apply or remove. Patent 1533971. L. Castracane, 462 10th Ave., New York, N. Y.

ANATOMICAL DISPLAY CASE.—For visibly acquainting the stockman with the pertinence of various hog remedies, displaying the internal portions of the animal. Patent 1536,-125. C. A. Moorman, c/o Moorman Mfg. Co., N. W. Cor. 58th St. and Drexel Ave., Chicago, Ill.

SUPPOSITORY INJECTOR.—So formed and arranged as to insure the proper insertion and application of the suppository while eliminating the possibility of injury, distress or discomfort. Two patents of a similar nature have been granted the inventor. Patents 1538678 and 1538679. J. S. Blinn, 195 Church St., New Haven, Conn.

MANUFACTURE OF DENTAL PLATES.—Of the so-called porcelain or mineral type, in such manner that the plate may be readily separated from the mold when completed. Patent 1538691. E. L. Dillman, 42 Flushing Ave., Jamaica, N. Y.

DENTAL PLATE.—Which when finished will have the appearance of porcelain, yet constructed of metals, not belonging to the so-called precious group. Patent 1538692. E. L. Dillman, 42 Flushing Ave., Jamaica, N. Y.

HOLDER FOR STETHOSCOPE.—Adapted to rigidly secure a stethoscope to the head of the operator, whereby the operator's hands will be free. Patent 1539046. E. M. Hartlett, c/o Evanston Hospital, Evanston, Ill.

Prime Movers and Their Accessories

PISTON.—For internal combustion engines, the piston being constructed of sections readily assembled to compensate for excessive wear. Patent 1536971. H. W. Pierce, 114 So. Montana St., Butte, Mont.

SPARK PLUG.—In which the only metal exposed on the inside of the cylinder is that contained by the electrodes. Patent 1537105. W. W. Woodroof, Box 834, Auburn, Ala.

MEANS FOR WASHING GASES.—In internal combustion engines, whereby the exhaust gases are passed through a reservoir of highly agitated water. Patent 1538335. A. J. Koehler, 5215 S. Laflin St., Chicago, Ill.

PULLEY.—For fans used in connection with the engines of automobiles, the device may be easily assembled with the shaft. Patent 1539791. C. H. Hertzler, Gracemont, Okla.

CUT-OFF VALVE FOR STEAM ENGINES.—Which permits a piston within a cylinder having its forward head broken to continue to make a forward power stroke. Patent 1539200. B. F. O'Bryant, c/o I. M. Rosen, 2012 Vliet St., Milwaukee, Wis.

Railways and Their Accessories

TRACK SUPPORTING DEVICE.—For temporarily supporting a track under conditions such as excavating requiring the removal of the customary support. Patent 1532981. V. St. C. Blackett, 229 Highfield St., Moncton, New Brunswick, Canada.

BONDING RAIL JOINT.—In the form of a fish plate which in addition to its ordinary function serves to electrically connect the rails. Patent 1533916. I. K. Johnson, Dood Road, West Caldwell, N. J.

TRAIN-STOPPING DEVICE. — Requiring no manual control, but must be manually set, the train stopping when it has passed a block set against passage. Patent 1536095. C. I. Haines and J. S. Bower, Aledo, Ill.

BALLAST-DRESSING MACHINE. — Adapted to be mounted upon any conventional railroad car, to serve as a sweeper for the roadbed. Patent 1538971. S. F. Clapp, Temple, Texas.

BOX-CAR DOOR LATCH.—For securing a freight car door in closed position so that it cannot readily be pried loose at the rearward edge. Patent 1538965. T. W. Allen and L. A. Wyatt, Paducah, Ky.

Pertaining to Recreation

BASEBALL GAME.—The apparatus includes a board showing a field and diamond, also a spinner indicating the movement of a batted ball. Patent 1532066. J. O'Connor, 3263 Perry Ave., Bronx, N. Y.

AMUSEMENT APPARATUS.—The inventor has been granted two patents of a similar nature, consisting of a vehicle having a traction wheel, and electric drive controllable by means movable relatively to the body of the vehicle. Patents 1534285 and 1535040. H. E. Riehl, 15 Bath St., Southport, Lancashire, England.

TOY.—Consisting of a handle adapted to pick up and resiliently hold a ball, but to release the ball when a throwing action is imparted. Patent 1535029. W. W. Murch, 39 Ashwood St., Brooklyn, N. Y.

GAME APPARATUS.—By means of which a golf player may practice the making of pitch shots indoors. Patent 1537809. E. C. Easton, 9 Inwood Place, Maplewood, N. J.

AMUSEMENT DEVICE.—In which a car simulating an aeroplane is caused to move in a circular direction, controllable by an operator in the car. Patent 1537791. G. Amundsen, Myrtle Point, Oregon.

FIGURE TOY.—With spring actuated mechanism, for representing boys playing what is commonly known as leap-frog. Patent 1537,-363. H. H. Martin, c/o New Albany Machine Mfg. Co., New Albany, Ind.

GAME.—In the form of a radio game apparatus with two dials which when turned will give a character to represent a broadcasting station. Patent 1539776. R. C. Scheurer and F. Greenberg, 508 Summit Ave., W. Hoboken, N. J.

Pertaining to Vehicles

SPRING CONNECTION.—In the form of a universal connection that will minimize the strains due to rise and fall of an axle. Patent 1536981. E. W. Stossel, Box 331, Asbury Park, N. J.

LICENSE-NUMBER-PLATE HOLDER.—Forming an attractive article which is durable, in which the plate can be quickly and firmly secured. Patent 1536414. R. W. Watts, Box 176, Tacoma, Wash.

DIRIGIBLE HEADLIGHTS.—Operated from the steering wheel, freely revoluble about a vertical axis and tiltable about its transverse axis. Patent 1536158. C. E. Sparhawk, c/o Mac Intyre & Sandercock, Attys., Drumbeller, Alberta, Canada.

FLOOR BOARD.—For automobiles having a molding which not only binds the edges, but lubricates the same, to prevent noises and rattling. Patent 1536182. J. M. Jackson, c/o Rope and Cordage Co., Parkersburg, W. Va.

TIRE.—Having shock absorbing qualities supplied by an annular series of springs, which may be conveniently applied to a wheel. Patent 1536225. P. A. Lea, Box 125, Littleton, Colo.

ATTACHING PLATE FOR SPRINGS.—Adapted to be positioned below the semi-elliptical spring on the front of a Ford automobile, to brace the intermediate portion. Patent 1536418. C. C. Breakfield, c/o J. B. Boyd, Allensville, Ky.

VEHICLE DUMPING BODY.—Having means for securely holding the body of the wagon against dumping movement, the dumping body locking in either its retaining or releasing position. Patent 1537765. F. M. Goossen, R. F. D. Box 50, Hillsboro, Kans.

MINIATURE AUTOMOBILE FOR EXHIBITION PURPOSES.—For use at public exhibitions, the automobile being automatically guided around a motordrome. Patent 1537198. W. E. Soldner, R. No. 3, Salina, Kansas.

RADIATOR CAP.—Which affords facilities for permitting a controlled flow of liquid into the radiator without detaching the cap. Patent 1537254. A. T. Mills, Highland, Iowa.

COUPLING OR HITCH FOR TRACTORS.—Whereby an implement of any type may be connected to a tractor, and drawn across fields raised free of the earth. Patent 1538,-757. S. L. Swindall, Box 240, Boynton, Fla.

SPRING SUSPENSION FOR VEHICLES.—Which will cushion side sway, thereby reducing skidding to a minimum, and eliminate the usual rattle. Patent 1538405. R. R. Love, 530 E. So. Temple St., Salt Lake City, Utah.

HEADLIGHT.—With means for protecting the eyes of an approaching driver or pedestrian from the glare of the light. Patent 1537909. H. M. Wolter, 3030 20th St., San Francisco, Calif.

VEHICLE BODY.—Which will permit of rapid transformation from an open to a closed carriage. Patent 1538781. G. Baehr, 2 Rue des Sablons, Paris, France.

PLATE LOCK.—By means of which a plate bearing the emblem or trade mark of a vehicle, may be permanently fixed to the radiator. Patent 1538320. J. Gullong, General Delivery, Holyoke, Mass.

DIFFERENTIAL.—Which provides a positive drive to a wheel in mud, or under circumstances where an ordinary differential would be ineffective. Patent 1538810. F. J. Herdle, 1847 W. Huron St., Chicago, Ill.

VEHICLE BODY CONSTRUCTION.—Providing a tonneau seat which can be moved to leave a clear space in the tonneau for carrying articles. Patent 1539764. V. W. Page, c/o Victor Page Motor Co., Stamford, Conn.

MOTOR SILENCER.—Characterized by a yieldable piston which is on the scavenger stroke to occupy the full volumetric clearance. Patent 1539769. G. W. Poillon, Jr., 37 Church St., Tarrytown, N. Y.

AUTOMATIC NOZZLE.—Which will control the filling of containers, such as automobile tanks, with gasoline, when a predetermined level is reached the supply is cut off. Patent 1539081. E. G. Fritz, Litchfield, Conn.

HEADLIGHT.—Which will be automatically operated by the steering mechanism of the vehicle, at all times illuminating the roadway. Patent 1539197. F. J. Long and W. H. Emery, Box 163, Carbondale, Colo.

AUTOMOBILE ATTACHMENT.—In the form of an auxiliary braking means either supplementing the usual brake or for acting independently. Patent 1539476. C. P. Gormly, 754 Orange Ave., Long Beach, Calif.

AUTOMATIC TRANSMISSION FOR MOTOR VEHICLES.—Obviating the necessity of manually engaging the first speed gears, as in the case of ordinary automatic transmission. Patent 1539188. H. R. Hoffman, 2069 Humboldt Blvd., Chicago, Ill.

Designs

DESIGN FOR AN ASH TRAY.—Patent 66,-962. E. Wismer, 1439 43rd Ave., San Francisco, Calif.

DESIGN FOR A LAMP SHADE.—Patent 66,-762. J. Bennici, Los Angeles, Calif.

DESIGN FOR A TABLE COVER OR THE LIKE. —Patents 67252 and 67253. J. H. Young, c/o Thomas Young, Inc., 42 White St., New York, N. Y.

DESIGN FOR A SHOE.—Patent 67240. H. Smolen, 24 Boerum St., Brooklyn, N. Y.

DESIGN FOR A RING.—Patent 67300. I. Ornstein and J. Mevorah, c/o I. Ornstein, 260 W. 23rd St., New York, N. Y.

DESIGN FOR A CHARM.—Patent 67299. I. Ornstein and J. Mevorah, c/o I. Ornstein, 260 W. 23rd St., New York, N. Y.

DESIGN FOR A PLATE OR SIMILAR ARTICLE. —Patent 67381. S. Haslam, c/o Evans Case Co., North Attleboro, Mass.

DESIGN FOR A TABLE COVER OR THE LIKE. —Patents 67252 and 67253. J. H. Young, c/o Thomas Young, Inc., 42 White St., New York, N. Y.

DESIGN FOR A SHOE.—Patent 67240. H. Smolen, 24 Boerum St., Brooklyn, N. Y.

DESIGN FOR A DRESS.—Patent 67354. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

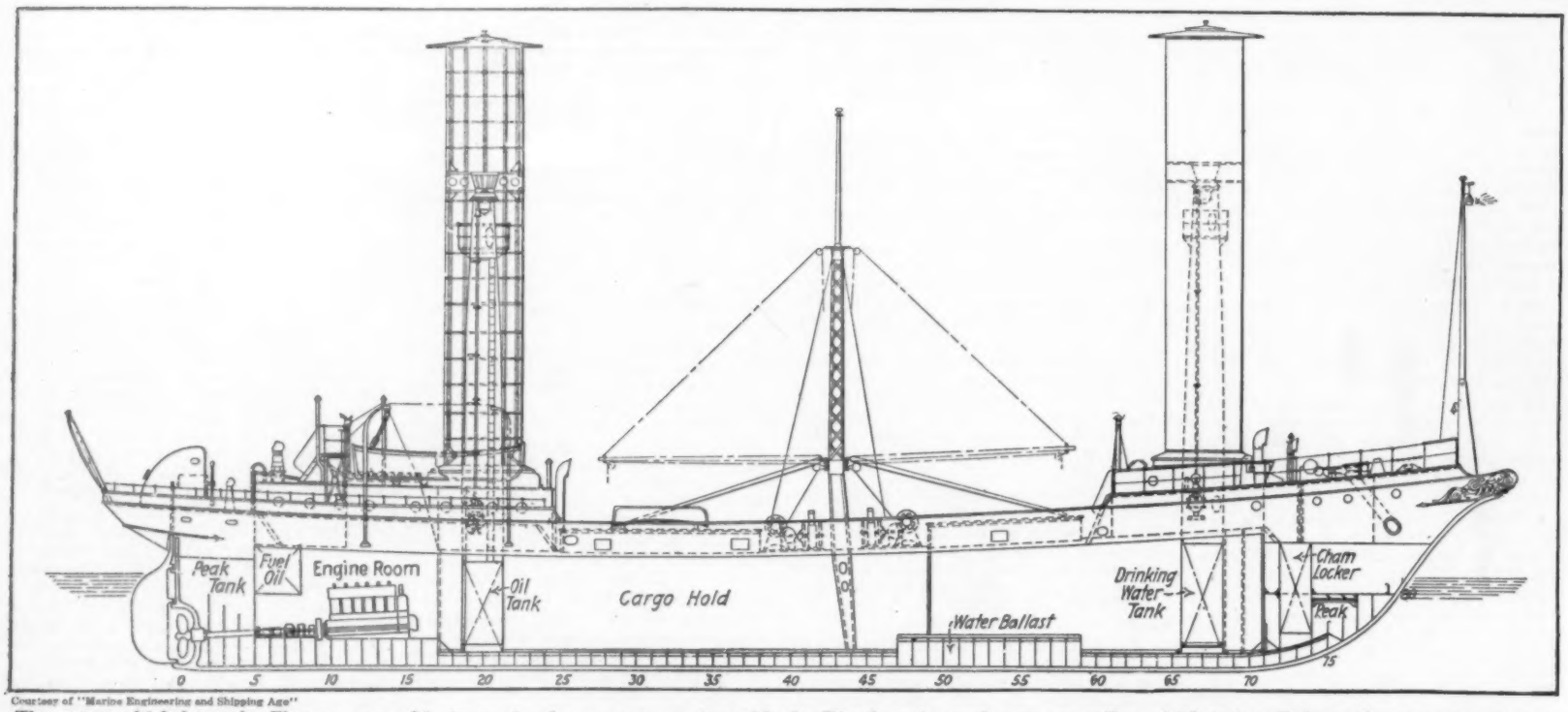
DESIGN FOR A RING.—Patent 67343. S. Hyman, 16 Park Hill Ave., Boston, Mass.

The Scientific American Digest

A Review of the Technical and Trade Press, Consisting of Abstracts from Leading Articles Announcing the Newest Developments in Industry and Engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals.
Other digests appear elsewhere in this issue

Conducted by Albert G. Ingalls



Courtesy of "Marine Engineering and Shipping Age"

The rotors which keep the Flettner rotor ship in motion have no connection with the Diesel engine and screw propeller, which is installed merely as a convenience. Note the detail of the rotors, their thin sheet-metal shells, their internal pivots reaching about two-thirds the total height of the rotors, and the gears which drive them through the long, vertical shafts of two small electric motors mounted near the deck level

Taking the Sensational Out of the Rotor Ship Story

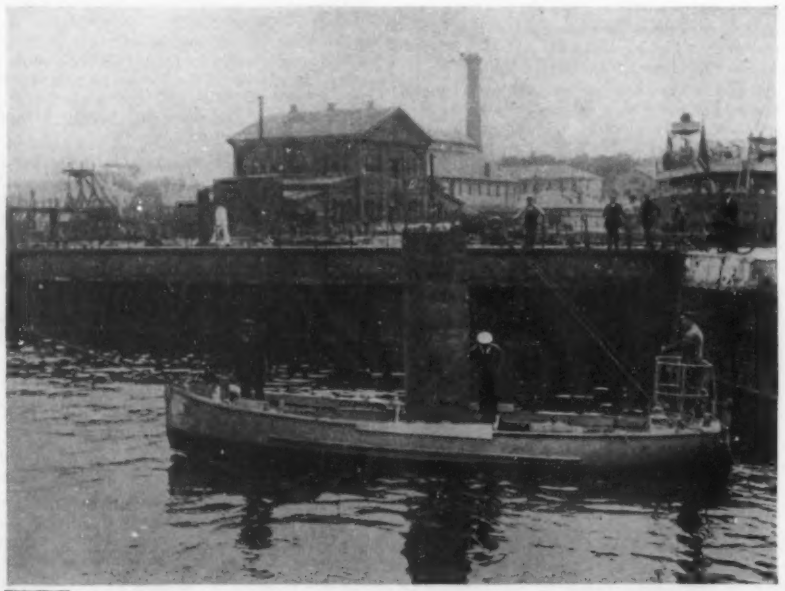
THOSE who were disappointed several months ago when the first announcement of the development of the Flettner Rotor Ship was followed by a number of newspaper and magazine articles giving rather meager details of the mechanism of the rotors, will take interest in a more detailed technical description of the parts that are concealed by the thin shell of the rotors and by the hull of the ship. These details have been secured from Dr. Ernst Foerster, a well-known German naval architect and engineer by *Marine Engineering and Shipping Age* (New York, May, 1925). The aerodynamic principle on which the rotor ship operates was considered in the February, 1925, issue of the Scientific American, as well as in several special technological journals. However, we believe that the internal mechanical details of the rotor mechanism have not before been illustrated.

The rotors are simply hollow shells made of steel plates 0.06 and 0.04 inches in thickness, stiffened by angle bars of 0.06 inch material, with one-half inch by one-half inch sides. The rotors are installed on bearings which are placed on the tops of the central pivots, concealed by the shell of the rotors. This pivoting is the vital point in insuring the safe working of the rotors when the vessel is in a heavy sea. Adjacent to the pivots the hull is specially strengthened by web frames.

The upper covers or caps of the rotors are not put there either for ornament or to keep the rain out. They almost double the effect of the rotors in propelling the ship, for they prevent the whirling air from escaping in an upward direction.

The whole construction of the rotors has been calculated to withstand heavy rolling of the vessel. This is of interest when viewed in the light of the statement frequently made when the rotor ship first made its appearance, that in a heavy sea the rotors would be liable to go overboard or would be wrenched to pieces by the rolling of the vessel. These cylindrical objects have a bulky appearance; but they are comparatively light in weight—lighter, in fact, than the sailing rig which they replace.

It is also of interest to note that in several cases where adverse criticisms were at first levelled against the rotor ship, they were based largely on statements made, not by its inventor, but by writers who had jumped to the conclusion that the inventor expected the rotor ship entirely to displace the steam vessel. Herr Anton Flettner, however, regards his invention chiefly in the light of an auxiliary to steam or other power; and as a self-propelled vessel only for certain routes where trade winds and other established winds blow in the most advantageous direction.



Wide World

America's first rotor ship, a crude but serious beginning, was constructed at the Massachusetts Institute of Technology ("Boston Tech") by Lieutenants W. W. Hastings and J. M. Kiernan of the United States Navy

Another detail which has caused widespread misconception is the fact that the rotor ship carries a propeller and engine. The purpose of this equipment is for maneuvering in port and for other convenience. It is not connected in any way whatever to the rotors. In fact, the rotors do not actuate any mechanical device; simply, when the wind blows they "suck" the ship forward, and this sucking force, which is actually a negative pressure, acts directly on the rotors. As these are attached to the ship, the latter is necessarily drawn along also. Thus the rotors move the ship just as if a giant had tied a line to the mast and towed it along.

It is, however, necessary to keep the rotors revolving, and for this purpose a forty-five horsepower Diesel-driven dynamo of the Krupp type is installed. This furnishes the power to keep the rotors spinning at the rate of about 110 revolutions per minute. On the main deck, inside of each rotor, is placed a direct current motor of fifteen horsepower. These motors are installed with their axes vertical and these axes are extended as hollow shafts to reach the gears at the top of the pivots on which the rotors rest and spin. These gears have a reduction of one in six. The weight of everything pertaining to the above deck mechanism is twenty-one tons.

The rotor ship has a lower center of gravity than the same ship had when it was a sailing vessel, the center of gravity now being only twelve feet above the keel instead of 14½ feet, as formerly.

The experience with the rotor ship, *Buckau*, and with numerous designs which have been calculated since the *Buckau* has been in service, shows, according to Dr. Foerster, that a certain limit for the dimensions of the rotors is set by nautical and technical considerations; and this has led

to the recommendation not to plan rotors of larger dimensions than necessary to give about fifty percent of the whole thrust required to maintain the speed of the vessel.

* * *

What Shall Be Done with Niagara?

RECONSTRUCTING Niagara Falls on a horizontal scale of one hundred to one was the interesting task performed under the direction of John L. Harper, president and chief engineer of a large power company at Niagara Falls, N. Y. The model was not constructed to amuse visitors and tourists, but to permit a careful, scientific study of a number of problems concerning the disposition of the waters of the Falls.

Left: **This replica of Niagara Falls was constructed for the purpose of making careful engineering studies of the flow of water over the American and Canadian falls. Compare it with the picture of the real Niagara Falls at the right**

The model measures about 100 by 125 feet. The vertical scale is somewhat less than the horizontal, permitting a better perspective view by a spectator standing nearby. In most of the essential details the model is remarkably exact, the rapids above the Falls being reproduced with remarkable fidelity. Although Goat Island is the same in outline and shore line, there is no need to make its surface identical with that of the real Goat Island, since the model is made to simulate only the water conditions. Note that the little islands are accurately placed.

The total flow of the Niagara River is 210,000 cubic feet per second, and that flow is remarkably uniform, considering that most streams fluctuate considerably. This uniform flow is one of the reasons why Niagara Falls is so valuable a source of power. If all the normal flow of the Falls were to be used it would be possible to produce 6,750,000 horsepower.

If all the water were used, as much power as that generated by all the electric central stations in the country, or that which could be generated by 33,000,000 tons of coal yearly would be available. Ninety-five percent of the water now falls over the Canadian Falls, leaving to the American side but five percent.

"What would be the effect of placing submerged weirs above Goat Island?" asked Col. W. D. Warren, U. S. Army Engineer. The model has provided the means for a test of this point. The effect of model weirs of this sort was to divert the water which seems to fall over the sharp angle of the Canadian Falls and to spread it out over the whole front. This would cut down the unequal erosion which is now taking place at the lip of the Canadian Falls.

The several water power houses now existing on either side of the Falls are reproduced in the model and are carefully designed to divert just the same proportion of water as the real power houses do in fact divert. The whole model is kept filled with water by means of a pump. A dial at the side of the model shows the amount of water flowing at any moment over the two sides of the Falls.

* * *

The Level of Great Salt Lake is Rising. Why?

UNDERNEATH the Pavilion at the Saltair bathing resort on the Great Salt Lake, Utah, there is a gage which records the height of the water level of the lake. The readings of this gage are watched each spring with almost feverish intensity by the engineers of two of the great transcontinental railroads. Weather bureau experts at Salt Lake City keep the records and give them close scrutiny. Men connected with the United States Geological Survey mark the readings with a high degree of interest.

Since 1920 the average level of the lake, year by year, has been rising. The lake is considerably higher than it was at the beginning of the century. The increases in level do not come steadily. There is a rise in the spring of the year, with high water in May or June, due to the melting of snow in the mountains and the consequent swelling of the rivers and the smaller streams that empty into the lake. Then, beginning usually some time in June, the surface of the lake gradually recedes. The irrigation of farms diminishes the stream flow. Hot weather increases the evaporation. The low level comes about the close of the year, when the flow of the streams is reduced to a minimum by cold weather.

J. Cecil Alter

This photograph was taken when the gage registered 3.9 feet above zero. In May, 1924, it showed 8.2 feet above zero

The lake reached its 1924 peak about May 1. The gage at the Saltair pavilion registered a height of 8.2 feet above the empirical zero point. The lowest point ever reached since Brigham Young led the original settlers into the Salt Lake valley, was in 1905 when the surface was 4.9 feet below zero on the gage. Therefore, on May 1 of this year the water was 13.1 feet higher than the lowest known point; higher than at any time since 1887.

The highest water ever known was in 1868. Had the Saltair gage then been in existence, it would have shown 13.4 feet. The lowest level recorded being 4.9 below the Saltair zero, the total known variation in the surface is 18.3 feet. Years in which the lake has been higher than it was on May 1, 1924, are those from 1867 to 1879 inclusive, and in 1885 to 1887.

At first thought it would appear easy to make an intelligent prediction as to whether the surface of the lake will rise, or fall. It is easy to say that the variations are dependent on the rainfall and the evaporation. Inflow would appear to depend on the measurements of the Bear and the Weber rivers and smaller streams that enter the lake, to which should be added the precipitation directly into the water. Evaporation would appear to depend on temperature, humidity of the air, and on the wind.

Yet the lake, in a measure, has defied those who would probe its secrets. If there is anything that seems certain, it is that a period of four years of precipitation above the normal, will cause a rise in the surface. Records of rainfall at Salt Lake City are the basis of this statement. Such records go back to 1874. The rapid rise of the lake level in 1875 and 1876 was probably due to the two years of rainfall heavier than normal and the absence then of irrigation projects. The next rise in 1884 to 1886 is marked by three years of heavy precipitation.

The six years from 1900 to 1905, inclusive, show an average rainfall of 14.03 inches in Salt Lake City, which is nearly two inches below the average normal rainfall. The lake dropped very rapidly in those years. The average precipitation for 1906 to 1909 was 20.26 inches. The lake level jumped about three feet in 1906, held steady in 1907 and 1908 and then rose rapidly in 1909, the rise from the first part of 1909 to the middle of 1910 being over seven feet.

Again, the average precipitation in 1920 to 1923 has been 19.16 inches—with a corresponding steady rise in the water.

To arrive at any definite conclusion, conditions other than rainfall must be considered. The question involves not only the rate of evaporation, which is dependent on sun, humidity and wind, but there enters, also, the quantity of water used for irrigation in the drainage basin of the lake, and the rate at which irrigation water seeps through the ground, this depending on the character of the season. Even the rate at which snow melts, which varies from year to year, is a factor. The evaporation rate is not definitely known.

Great Salt Lake is unlike every other inland body of water, being merely a skim of intensely salt water; a remnant of a prehistoric body of water of far greater area, called by geologists, Lake Bonneville, from its discoverer. The average area of thirty by eighty miles varies greatly with the height of the water. The average depth is from twenty to thirty-five feet. To the west and south are extensions of almost level land—the bottom of the pre-historic Lake Bonneville. Therefore every foot of rise vastly increases the area.

To the railroad company which has a trestle twelve miles long with long rock fills at each end, directly across the lake, it is a matter of dollars and cents to keep their lines open. Every student of meteorology is familiar with what is going on. Of theories about the present rise, there are no end. Yet over it all there is an air of mystery, of acknowledged uncertainty, of waiting to see what 1925 will develop.

* * *

Talking with Artificial Vocal Cords

THOSE whose larynx has been removed may speak again by means of the rubber, artificial larynx recently developed by Dr. Harvey Fletcher and Messrs. Wegel and Lane, engineers of the Western Electric Company, along the lines of a plan sug-

Courtesy of "The India Rubber World"

The rubber larynx which takes the place of the natural larynx when the latter has been removed by surgery

gested by Dr. John E. Mackenty, of New York. By holding in their mouths a hard rubber mouthpiece and modulating the vibrations which are produced in an attached cylinder containing a vibrating membrane of pure rubber, these people may produce speech which can easily be understood. This kind of speech differs from natural speech, it is true, being a low-pitched monotone; but it is perfectly intelligible.

The artificial larynx is connected to the user's throat at the point where his windpipe, owing to the surgical operation of removing the larynx, communicates directly with the open air. The patient may wear the talking apparatus all day without trouble, with a layer of gauze underneath to keep dust out of his lungs, the apparatus being held fast by means of tapes around the neck and chest.

Since one must continue to breathe, even while wearing an artificial talking device, there is a side opening in the rubber larynx through which one's breath is regularly drawn in and expelled, just as this was formerly done through the nostrils. While the wearer is actually talking, this opening can be temporarily closed by the thumb.

Air forced from the lungs is set into vibration by the vibrating membrane and these vibrations are carried into the speaker's mouth through a short tube like a pipe-stem. The rest of the operation remains to be performed by the mouth, tongue, and teeth in the same manner that the vibrations arising from an uninjured person's vocal cords are modulated by these parts of the anatomy. So clear is the enunciation that conversations may be had over the telephone by the user of this device.—*The India Rubber World* (New York), vol. 72, pages 340-341 (Mar. 1, 1925).

* * *

Radio-acoustic Range Finding

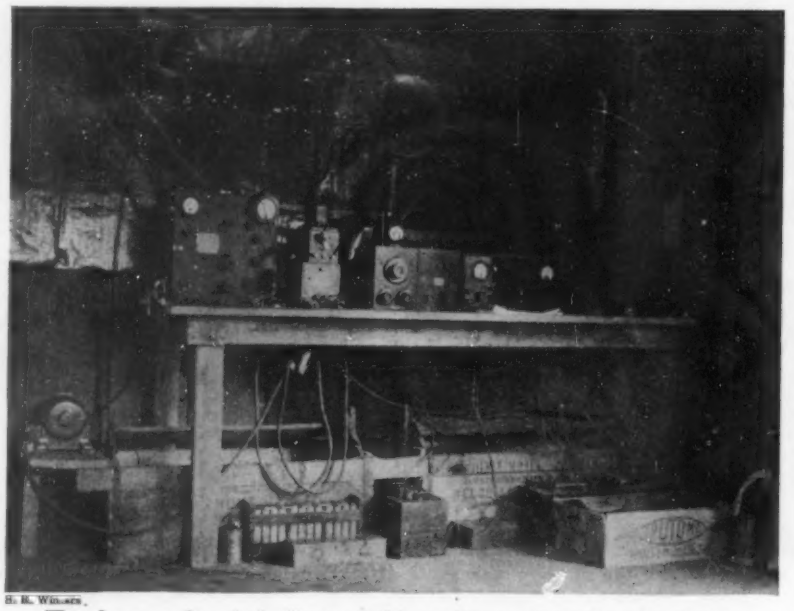
IMAGINE a blind man trying to make a survey on land. Then think of a surveying vessel trying to get an accurate position in a dense fog when 40 or 50 miles offshore. These two things seem equally impossible, yet the second one of them is being done daily by the new radio-acoustic method off the coast of Oregon by the officers of the Steamer *Guide* and by members of the Coast and Geodetic Survey.

In this newly evolved method of determining the position of a ship the difference in the speed of sound waves and electromagnetic waves is taken advantage of. The latter, traveling at the rate of 186,300 miles a second, may be said to reach a nearby destination instantaneously. The velocity of sound in sea water is 1,600 yards per second. Radio sound ranging involves the transmission of a sound from ship to shore, and the return of a radio signal at the instant that the sound wave reaches its destination. The distance from the source of the sound is measured by noting the time elapsed between the transmission of the sound wave and the arrival of the radio return signal.

Three observing points on land use hydrophones, sensitive instruments for detecting sound through water. These underwater microphones are submerged 60 feet, just off shore, with a cable leading to the land stations. A bomb is fired from a vessel which desires to determine its position in fog or low visibility weather. This bomb-created sound, upon reaching each hydrophone, automatically releases a radio signal which is recorded on board the vessel at the time of arrival of the sound at the shore station. With three shore stations thus heard from, the distance of the vessel from each observing point and its position from shore are then a matter of simple calculation.

E. E. Winters

Planting the sinker, with its hydrophone and cable attached, in sixty feet of water



E. E. Winters

The shore outfit. A duplicate of this equipment is used on board ship

The bomb is fired by means of a snap switch, which not alone explodes the TNT, but also records the moment of the closing of the firing circuit. The sound, upon reaching the hydrophones, is translated by it into an electrical impulse, and by means of radio-amplifying equipment, it is amplified to such an extent that it will actuate a relay. The latter causes a clockwork to function, and this rotates a code wheel. This, in turn, operates a second relay at specified intervals from the start. The second relay operates the radio transmitting equipment by means of which signals are sent at intervals determined by the code wheel. The first signal on any of these wheels occurs not less than five seconds after the clockwork has been put in motion. This affords opportunity for switching on the transmitter after the clockwork of the automatic key has started to function.

The data sought with respect to the location of a ship from known shore stations may be completed by finding out the lag. This is done without altering the operation of the ship. But here no bomb is discharged and the switching from sending to reception of radio signals must be effected in less than five seconds. In the determination of the lag, the radio signal at the shore station is caused to actuate the relay which previously was operated by the sound signal. The automatic keys at the three shore stations are started at the same time. The records on the chronograph of the vessel, therefore, give the elapsed time from the sending of the wireless signal to the reception of each signal from the station located on land. These intervals, once measured, afford information relative to lags. In determining a lag, the operator at a shore station is bound to switch from "receive" to "transmit" positions after the automatic key has started, and before the initial signal of the code is transmitted thereby. This minimum time element is of about five seconds' duration.

The equipment necessary for charting the ocean by means of a combination of radio and sound is shown in one of the photographs illustrating this article. The units are seven in number. There is a radio receiver, amplifier and relay, designed and built at the Bureau of Standards; a chronometer and relay; a chronograph, the invention of Dr. E. A. Eckhardt of the Bureau of Standards; and pen magnet; radio transmitter; triple-pole firing and marking switch and safety switches. The radio receiving unit employs a detector and two stages of amplification. WD-12 vacuum tubes are used, their filaments being lighted by dry-cell batteries.

Courtesy of "Science".

The undertow is intermittent, not steady

The performance at the three shore stations is a duplicate of that on shipboard, with the exception that the code wheels are adjusted to send radio signals at different intervals between each other and with variations at the start. The radio signals originating from the three shore stations are intercepted by the antenna on the ship and by means of radio instruments they are recorded on the same chronograph drum which records the signal which indicates the moment of the explosion of the charge of TNT. These signals are identified with respect to the stations from which they emanated by their difference in spacings, and the time intervals between the discharge of the bomb and the arrival of each signal from a specified station.

The equipment used at the shore stations includes hydrophones, a power amplifier and relays, radio receivers, automatic keys and relays, transmitters, and power supply.

* * *

Is the Steady Undertow a Myth?

THAT the dread undertow of the ocean bathing beach is largely a matter of the bather's own psychology is the claim of Professor William M. Davis, noted Harvard University physical geographer.

Most people think of the undertow as a strong, treacherous, steady current that is always trying to draw them out to sea. But Professor Davis asks where, if the undertow is the steady current it is reputed to be, does the water come from? It cannot run away from the land steadily unless it first comes in, and the evidence is that it does not come in with sufficient volume to maintain a steady outward flow around the bather's feet.

"Is it not therefore probable," argues Professor Davis, "that the idea of a persistent and dangerous seaward undertow comes more from the excited imagination of unpracticed bathers than from the deliberate observation of good surf swimmers?"

When carefully observed, the undertow is found to be intermittent, but there are other factors which tend to obscure this fact. If one who is a fearless swimmer will dive under the oncoming waves and keep his presence of mind he will note by looking at the sandy bottom that the water is actually undertowing shoreward instead of seaward for a few seconds of each wave cycle.

Professor Davis asks us to follow through the sequence of events as a short series of waves beats upon a beach.

First a wave surges up the beach and the same volume of water slides back seaward (R, in sketch). This current may be felt at the bottom, but its flow is interrupted by the arrival of the next wave, S.

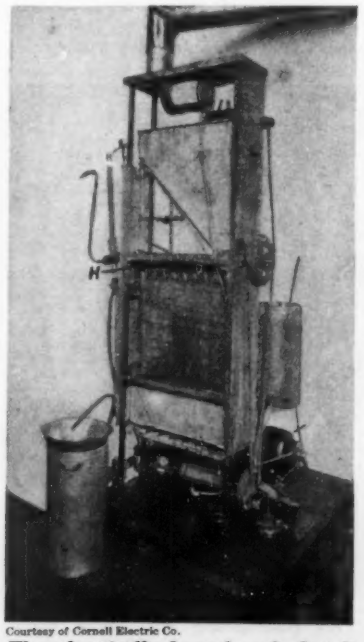
Here the inexperienced bather becomes flustered, for the top of the next wave, F′, smothers him and blanks out the sensations coming from his feet and legs, which would otherwise advise him that the undertow has now stopped.

By the time he has again collected his senses the undertow has begun again, but he thinks it has been moving seaward all the time, for the strong ebb of E′ now strikes him from behind and the next wave (through which if he were experienced he would dive, but being inexperienced does not) topples him over.

He is now in no fit mental condition to note that the next ebb is only a second ebb, E″, eight or ten seconds after the first. Its drag helps to impel him toward the next wave, F″, where he is again ducked, and is further discomfited.

Thus his most conscious, normal moments have coincided with the intervals during which the intermittent undertow has been moving seaward. He thinks, therefore, that there is a powerful and ever steady seaward undertow which is bent on carrying him out into the ocean where he will drown.

Whenever the actual flow of seaward moving undertow struck him he had his feet on the bottom and thus became acutely conscious of it. Whenever the high wave that stopped the undertow came along he was trying to keep his head above water, and thus his feet did not touch bottom. Hence he did not realize that he had been moved



Courtesy of Cornell Electric Co.

The electrically heated and electrically driven device which makes new oil out of old

bodily shorewards, not seawards, at such times.

It stands to reason, moreover, that no more water can flow out to sea from a beach than comes in; and since it comes in intermittently, it must go out in the same manner. That even the shoreward flow is of much smaller volume than one would at first blush think may be proved by watching any floating object. The waves rise and fall under it, but they move it ashore comparatively slowly.—*Science* (New York), vol. 61, pages 206-208 (Feb. 20, 1925).

* * *

Reclaimed Motor Oil Better Than New

A NEW method of economical operation of fleets of motor trucks and automobiles has been opened by the invention of equipment for reclaiming crank-case oil. The apparatus, developed in the research laboratory of the General Electric Company by Charles Van Brunt and P. Schuyler Miller, removes the products of combustion, debris of wear, road dust and fuel dilutants from the oil, and returns to the oil all of its original lubricating properties.

During the World War it was observed by American aviators that oil which had been used for the regular number of hours and discarded could be put into better condition than it ever was before by a reclaiming process. The reason that oil has to be drained from the crankcase periodically and replaced by new oil is not that the oil is worn out, but that it accumulates several kinds of impurities due to motor wear and from the air taken in through the carburetor.

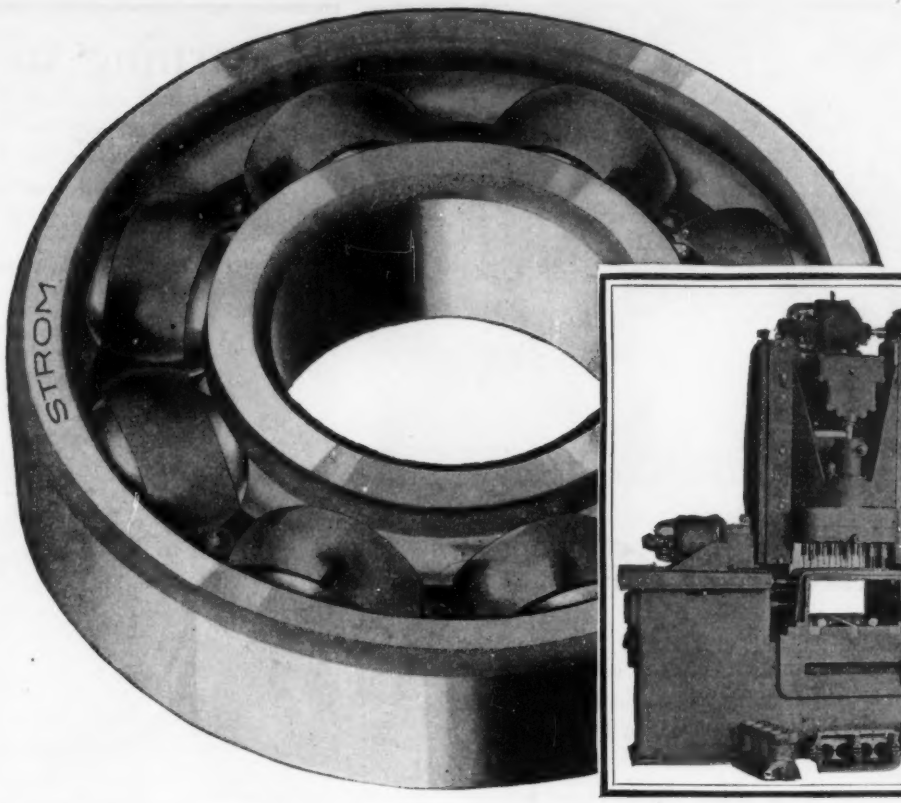
When the oil was properly reclaimed it seemed to the army aviators that it was better than ever, and they frequently expressed a preference for reclaimed oil.

The reason why the reclamation of used oils drained from the crankcase has not sooner become general is owing mainly to the practical difficulties of devising a reclaiming apparatus that would handle oil on a sufficiently small scale to warrant its purchase by others than those who have used oil in immense quantities to reclaim. What was wanted was a reasonably small outfit that would make oil reclamation a paying proposition for the owner of only a few cars or trucks.

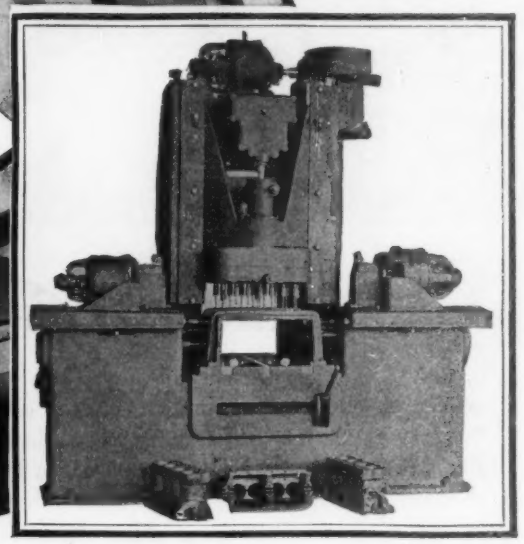
The two major steps in the reclamation of the oil include clarification by agitation with a small amount of silicate of soda, or water glass, and other chemicals, followed by rectification in which the oil is run in a thin film over a heated surface in a current of air. The oil is first heated by contact with the outlet pipe, and is then delivered to the mixing tank where the chemicals are added. From there it goes to the settling tank or clarifier, and then to the heated rectifier where it is refined and purified. The completely reclaimed oil is then led to storage tanks.

The new device is a continuous reclaimer, with a capacity of nine gallons of oil in twenty-four hours. It is automatic in operation and can keep the oil for thirty engines, of five quarts capacity each, in good condition indefinitely. The complete machine is so designed that, by removing the side panels, any number of units can be assembled side by side and driven by the same source of power, thus enabling the capacity to be increased as desired. A 100-gallon installation of twelve units would thus occupy a floor space about fifteen by fifty inches, exclusive of feed and receiving tanks and motor. The apparatus can be operated without technical control.

One of the surprising characteristics of the reclaimed oil is that its stability may be even greater than that of the original oil. This is because the less stable constituents of the lubricant are broken down when the oil is first used, and are removed during the reclaiming process. The reclaimed oil is of darker color than the original, but can be readily bleached by Fuller's earth. This bleaching process is not recommended, however, since it is believed that the portion thereby removed has the best lubricating properties.



25-Spindle Drill equipped with Strom Ball Bearings



Double-acting thrust bearing, flat seats (grooved races) 2100-F Series

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Single-acting, self-aligning thrust bearing, leveling washer, 1100-U Series

Double-acting, self-aligning thrust bearing, leveling washers 2100-U Series

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Announcement

Fully appreciating the vexatious problems that confront book-lovers in securing books from an endless list of publishers, the Book Department of the SCIENTIFIC AMERICAN has arranged to supply the books of all publishers directly to the reader, relieving him of the necessity of prowling all over the world to get the books wanted.

To you it is a one-source system at no additional cost for the service, the prices being those of the publisher plus a nominal sum for postage.

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First of all, telephone rates in the United States are the lowest in the wor' ' for the service given. Here, since the beginning, the best service for the greatest number of people has been the ideal. By constant improvement in efficiency and economy the Bell System has brought telephone service within the means of all. From the start, its rate policy has been to ask only enough to pay fair wages and a fair return on investment.

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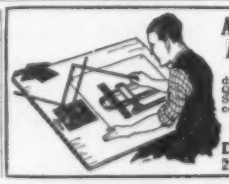

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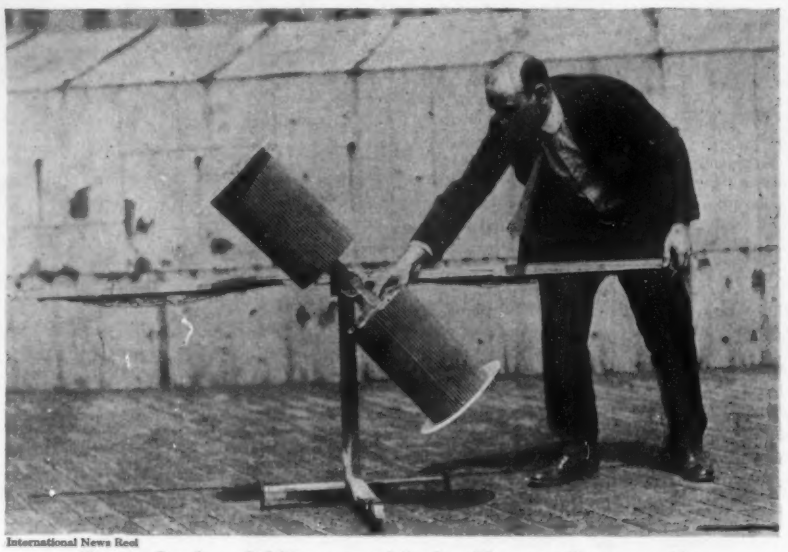
Conducted by Alexander Klemin
Associate Professor of Aeronautics, New York University



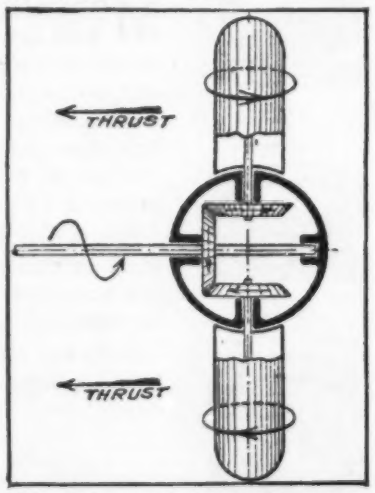
International News Reel
George Jacobs exhibiting a model of a Magnus effect propeller

A Magnus Effect Propeller

WHEN a rotating cylinder is placed in a current of air it experiences an upward force, in accordance with the Magnus effect, mentioned so frequently in the columns of the Scientific American of late.

Suggestions for the application of the Magnus effect to every possible end are now being made. The probabilities are that the Flettner rotor ship will prove the sole practical application, although an airplane sustained by a rotating cylinder is theoretically conceivable. So is a propeller based on the Magnus effect.

Mr. George Jacobs is seen in our photograph demonstrating his model of a rotor propeller. Certainly such a propeller will give thrust whether it is revolving at a fixed point or moving through the air. The second of our diagrams indicates clearly why as the propeller revolves about its main axis with each blade turning about its own axis, the device experiences a forward thrust. But whether a Magnus effect propeller is as efficient as an ordinary propeller is a different proposition. We are inclined to doubt it. The ordinary propeller derives its thrust from the summation of the left of its aerofoil elements, working with real efficiency. The rotating cylinder has so far failed to show anything like an equal efficiency in lift over drag ratio.

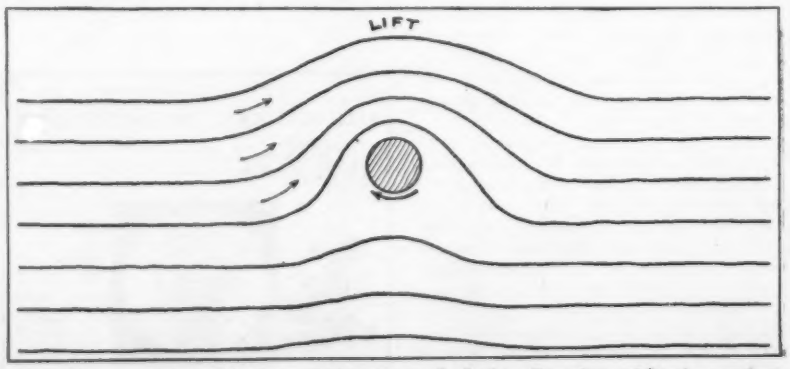


The Magnus effect propeller turns about its main axis, while at the same time each blade revolves about its own axis

More Power; Less Weight

IN 1923 Lieutenant Alford J. Williams, U. S. N., established a world's speed record of 266 miles per hour on a Curtiss-Navy racer. Since no new planes were built in the United States for the Pulitzer races of 1924, the speed record presently passed to the French, with the Ferbois monoplane doing 278 miles an hour. The Army and Navy air services have now placed a joint contract with the Curtiss Company for this year's Pulitzer trophy, and there is hope of beating the tremendous French record.

Engineers are enjoined by the Government to keep their designs strictly secret. This much information, however, is available: in



The Magnus effect cylinder rotating in a clockwise direction with air coming from the left will experience an upward lift force

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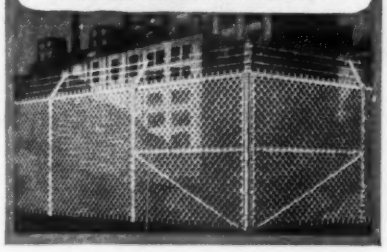

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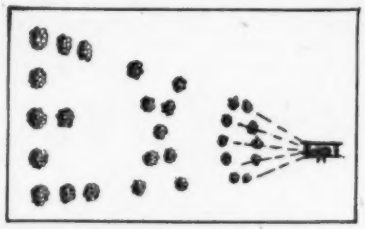
AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.

the designs of the new planes themselves but little improvement is being made. It is in the motor that startling development is taking place.

The 1923 Curtiss D-12 motor developed 400 horsepower and weighed 671 pounds. This year's Curtiss motor, termed the V-1400, turns up 512 horsepower and weighs only 655 pounds. In spite of the exceedingly low weight per horsepower the motor has passed all its reliability tests.

Sky-printing

A NEW method of sky-writing, more appropriately termed sky-printing, has been invented by an Englishman named Bailey. From an airplane, flying one to two miles high, groups of fireworks are fired (colored stars at night or smoke-puffs during the day) to produce letters or numerals.



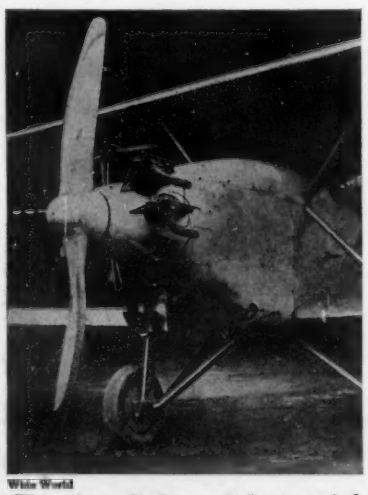
"Sky-printing" by means of firing letters into the air from pistols is cheaper than previous forms of "sky-writing"

The apparatus is simple. It consists of small firing machines, each comprising a number of inter-connected Very's pistol barrels pointing in different directions. When the pilot pulls a lever each one of these machines fires a group of fireworks into the air, where they burst simultaneously forming a letter about 80 yards square. An average advertisement fired letter by letter is complete in ten seconds. The fireworks being projected 300 feet or more from the airplane before bursting are free from the wash of the plane and are said to produce a lasting advertisement.

An Air-cooled Triumph

THE air-cooled engine is less vulnerable to bullets than a water-cooled engine, lighter in itself and free from the weight and complication of the radiator and water system. The difficulty is in adequate cooling with the high compressions and temperatures that spell efficiency. This is particularly the case for large air-cooled cylinders where the cooling surface is proportionately smaller than the combustion chamber. Also the air-cooled motor has a larger area projected perpendicularly to the line of the wind, and therefore, more parasite resistance.

The engineers of the Wright Aeronautical Corporation, working in close touch with the Navy Bureau of Aeronautics, seem to have solved most of these difficulties. In a new



Wide World

The nine-cylinder radial air-cooled engine developed by the Wright Aeronautical Corporation. The parasite resistance of the air-cooled motor has been largely eliminated by streamlining

To Executives Who Must Conserve Time—

Precious hours have a habit of slipping by almost unnoticed. Too much business detail is often the cause, consuming time that should be devoted to bigger things.

How to conserve time—that is every busy executive's problem. Cyclone Fence, enclosing industrial property, is a step in this direction. Cyclone Fence promotes order, helps to establish system, prevents outside interference, trespass, theft, vandalism. Thus, it eliminates many annoying, time-consuming problems in administration.

Cyclone Nation-Wide Service—
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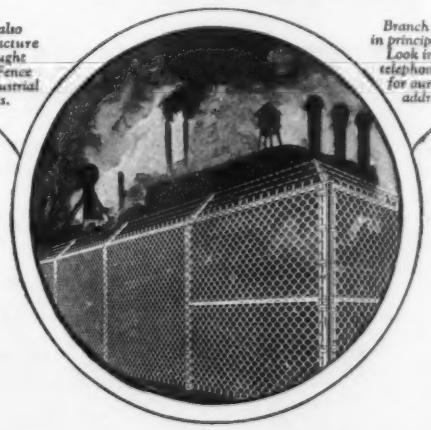

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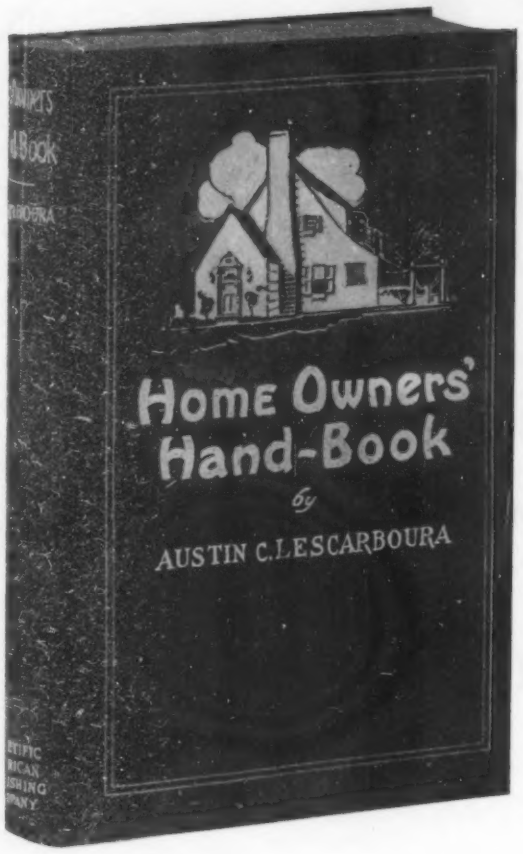

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model, termed the cyclone, a nine-cylinder radial air-cooled motor, 450 horsepower is developed in a power plant which weighs only 840 pounds complete with all accessories, piping, controls, and so on. The power plant of the 400-horsepower Liberty motor weighs 1,300 pounds with its 200-pound radiator and water system.

By installing the Cyclone motor in lieu of the Liberty motor in a Douglas World cruiser type of plane, a remarkable improvement in performance has been secured. This is due not only to the lighter weight, but also to the skillful manner in which everything but the cylinders and exhaust pipes of the engine are streamlined into the cowling, as shown in our photograph.

Incidentally the Cyclone has one of the largest air-cooled cylinders ever built in the world, with a six-inch bore and a six and one-half-inch stroke. Skillful and generous disposition of the highly conductive aluminum fins has given the necessary cooling and made these large dimensions possible.

Wide World

West Point Cadets receive aviation instruction at Mitchel Field, Long Island. Divided into two groups, the graduating class will receive a five-day course

Airworthiness

IN the same week accidents were reported to the non-rigid American airship the *TC-3* and the English rigid *R-33*. The *TC-3* with its rudder out of commission landed at Black Walnut, Missouri, without difficulty, although losing some $14,000 worth of helium in the process. The *R-33* provided in its mishap a striking example of airworthiness. Torn away from the mooring mast at Pulham airdrome in Norfolk, England, in a gale of 50 miles an hour, the *R-33* successfully emulated the *Shenandoah* and, although blown as far as the Dutch coast, across the North Sea, painfully but surely found her way back home.

The airship in breaking away, tore the arm of the mooring mast, broke completely the first transverse framework and damaged severely the second of the eighteen sections into which she is divided. The outer envelope was rent badly for one-sixth of the distance along the hull and hung in great folds as far aft as the beginning of the letters painted on the hull. Yet two minutes after she tore away the engines were working and the wireless was in operation. Very shortly after, to prevent the envelope from ripping further, men went aloft, lowered a rope ladder over the bow, gathered up the loose ends of the flapping silk and tied them together. They made untidy balls but still prevented the silk from ripping further.

Quite evidently the design of the bow of a rigid needs change, so that tearing away will not involve such great damage, but nevertheless this accident just as that of the *Shenandoah* is reassuring as regards the robust qualities of these air giants when once in flight.

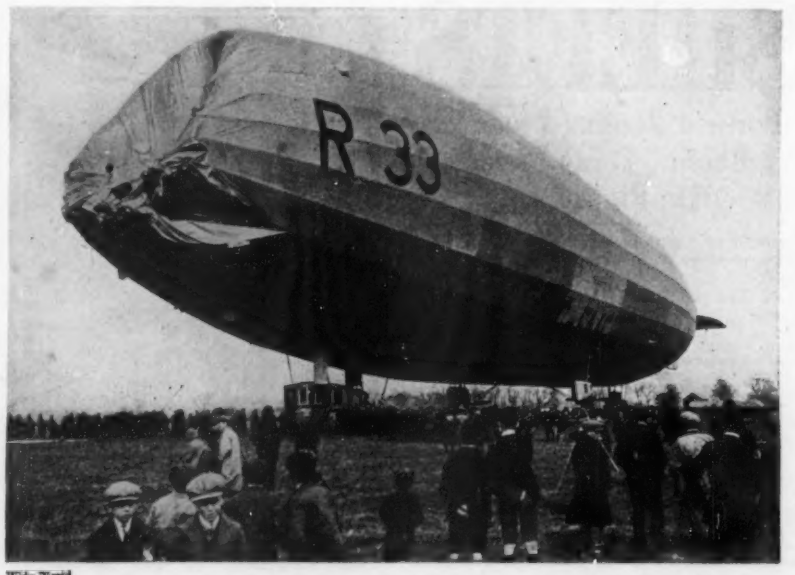
A Commercial Boom

SOMETHING like a boom in commercial aviation is in process. Edsel Ford, writing in the *Nation's Business*, predicts that aircraft will soon play as important a part in the life of the United States as the use of radio, and that we shall soon see "truly the age of the air."

The Fords, father and son, hardheaded business men as they are, are "sold" on aviation. They have donated an airport to the City of Detroit, are building an airship mooring mast there, and have inaugurated an air line which will be operated with Stout all-metal monoplanes between their factory in Detroit and the one in Chicago. They witnessed the maiden flight of the Stout plane on this route recently; our photograph commemorates this interesting event.

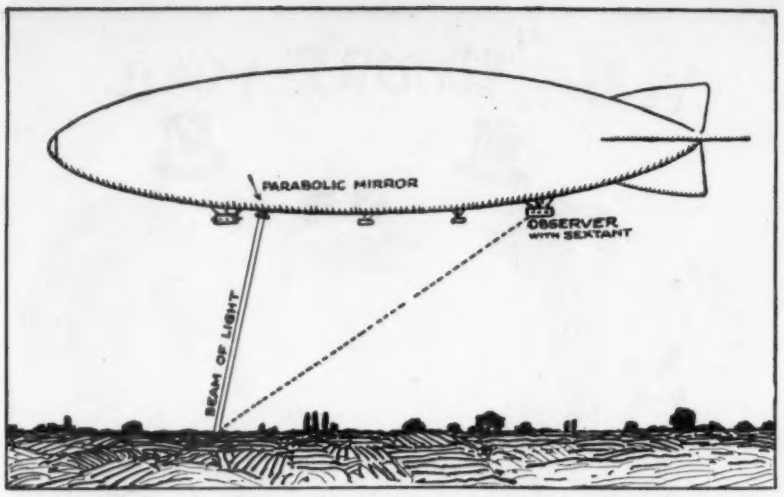
At the same time, Henry Ford, Charles M. Schwab, C. M. Keys, Clarence Dillon and others have formed an air line of $3,000,000 capital to operate between New York and Chicago.

Just as significant and helpful as these events is the passing of the so-called Kelly Bill by the last Congress, reinforced by



Wide World

The *R-33* safe at Pulham. The photograph shows the battered nose of the airship which was torn away when the airship broke from her moorings



A parabolic mirror helps the aviator gage his height above the sea

appropriations of half a million dollars.

This bill authorizes the conclusion of contracts with private individuals with the proviso that the total compensation will not exceed four-fifths of the postage on the air mail carriage. It thus appears that the appropriation is merely a working capital which will return to the Government through postage. Therefore, the amount of business that may be done is large in proportion to the working capital.

The Postmaster General is energetically following up the opening that the Kelly Bill gives him. Postmasters all over the country are asked to investigate the possibility of obtaining air mail in their cities, and the justification for extending air mail to certain routes.

The granting of contracts to private companies for carrying air mail is already being seriously considered for such routes as New York and Boston; Chicago and St. Louis; Los Angeles and Salt Lake City, Elko, Nevada and Pasco, Washington; Minneapolis-St. Paul and New Orleans; and Chicago and New Orleans by another route.

Aerial Depth Gages

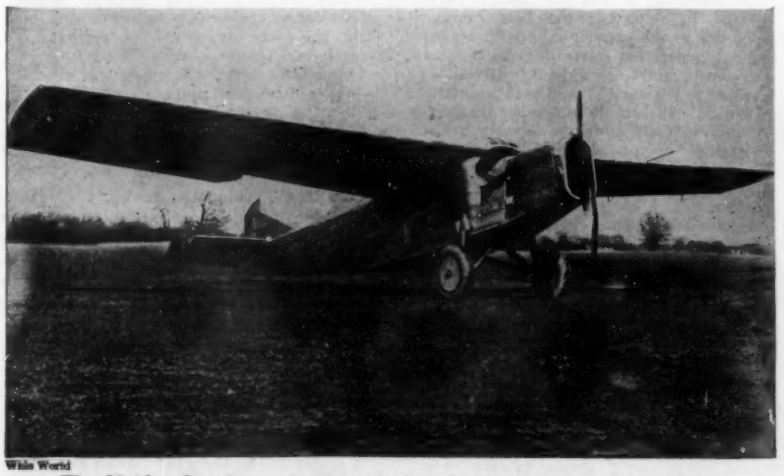
TO predict weather the barometer still remains the best guide. On board an airship, however, the problem is complicated by the fact that the barometric pressure is affected by altitude above sea level. To interpret his barometer correctly, therefore, the airship navigator must be able to gage his height above the sea independently of pressure observations.

In a series of articles on the dirigible published in the Scientific American, the importance of a device to measure the height independently of the altimeter was emphasized by the writer of these notes, and several interesting suggestions have since been received. It appears that the German navigators of the *LZ-126* or the *Los Angeles* had available on crossing the Atlantic at least two practicable methods of getting the true height.

The first method depends on an application of trigonometry, and the use of very simple apparatus. At the focus of a parabolic mirror a 100-candlepower lamp is placed, having but a single filament. The filament is reflected on the water as a narrow streak transverse to the keel of the ship. The reflecting apparatus is placed in the passageway along the keel; some 250 feet away from it is an observer's station. The observer armed with a sextant measures the angle between the line of the passageway and the line drawn from his eye to the reflection of the lamp in the water. With the aid of a simple table he can then immediately obtain the elevation above sea level.

The second method depends on the reflection of sound from ground or water as an echo. The speed of sound is a constant quantity. If the time it takes to travel from the airship to the ground and back is measured, the elevation is immediately calculable. The apparatus that has utilized this principle successfully is the Behm aerial depth gage and it is said to give results accurate within a few feet. Cartridges are detonated at some distance below the airship. When the sound of the detonation strikes a "sound receiver," breaking an electrical circuit of which the sound receiver is a part, a magnet is deprived of its magnetizing current and a tensed, flat spring is released. The spring imparts an impulse to a time registering wheel which revolves with great accuracy on a spindle mounted in sapphire bearings. When the echo of the detonation returns from the ground or the sea and strikes the sound receiver, an electro-magnetic brake comes into action and the time-registering wheels stop immediately. The degrees through which this wheel has turned indicate the time taken by the sound to travel downward and back.

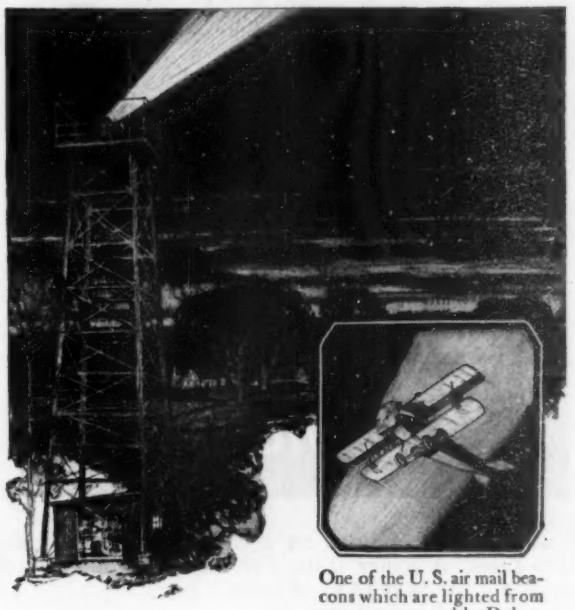
Since the sound receiver is not screened and may be affected by other sounds, an auxiliary mechanism puts the sound receiver out of commission until approximately such time as the echo may be expected to return. With a little adjustment and trial the operator can get the height in a few minutes.



Wide World

The *Maiden Dearborn*, the first airplane built at the new Ford airport

FACTS ABOUT A FAMOUS FAMILY



One of the U. S. air mail beacons which are lighted from power generated by Delco-Light electric plants.

Lighting the way of the mail planes

General Motors has contributed to the safety and surety of the air mail.

Delco-Light electric plants, a General Motors product, furnish the current for 50 of the 54 beacons which light the night route of the mail planes from Cleveland, Ohio, to Rock Springs, Wyoming—a distance of nearly 1,500 miles.

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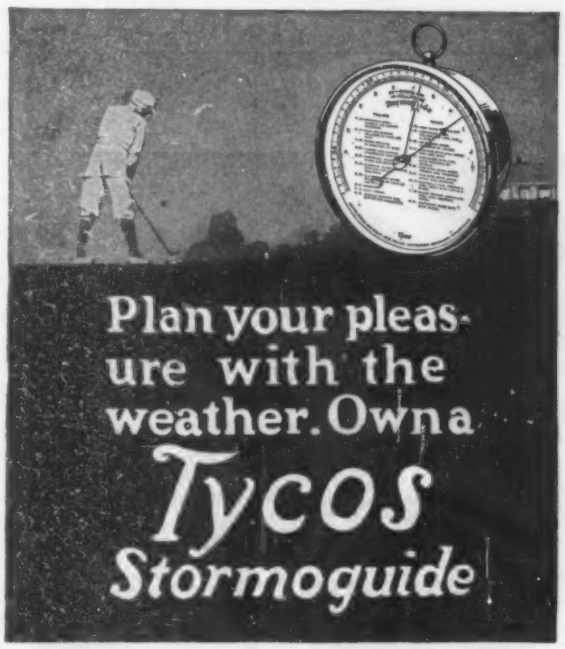

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Dumore Fractional H.P. Motors

We Blush

INCIDENTAL to asking for more specific information concerning an item in the Scientific American, this reader compliments us profusely. Perhaps sufficient modesty should deter us from publishing his letter, but we are rather proud to be the recipient of such flattering remarks. We try to merit the approval of our readers, and it helps us along to know that we succeed in this effort.

White Plains, N. Y.

Dear Editor:

If you can—and will—give me the name and address of the manufacturer of the plastic wood described in your issue for February, 1925, I shall be very much obliged to you.

Perhaps, to insure a proper interest in this request, I ought to add that I have read every issue of the Scientific American from the days of my early boyhood to the present ripe middle-age, that I would sooner part with all my other magazines than this one, and that, whatever might be said of the old, rather dry and matter-of-fact weekly, the present magazine is to my mind close to an ideal combination of skillful choosing, technical accuracy and interesting presentation; but, though all of that were true, I shall say none of it for fear of being accused of attempting to buy a service that you would prefer to render gratis.

Walter J. Spiro.

A Correction

FROM across the sea comes a letter calling attention to an inaccuracy in an article which appeared in our March issue entitled "What Becomes of the Energy Contained in a Ton of Coal." Mr. Brownlie goes after us "hammer and tongs," and this is what he has to say:

46, Grange Road,
Ealing, London, W. 5.

Dear Editor:

I was very interested to note in your March issue a full-page illustration entitled "What Becomes of the Energy Contained in a Ton of Coal." It is stated in this that the best average practice at the present time with regard to the generation of steam is 75 percent efficiency, and that only 0.1 percent is lost in radiation. This is such an extraordinarily inaccurate statement that perhaps you would allow me to make a few comments upon it.

In the first place, of course, the illustration features a locomotive type of boiler, which presumably, however, is merely intended as generally representing all designs of boiler, and as it is shown entirely unlagged the radiation losses may be anything from 5 to 10 percent, depending on the conditions. With the most efficient lagging possible, however, a cylindrical boiler will lose at least 1.5 to 2 percent of the heat, and a figure of 0.1 percent is ludicrous.

The idea that the average boiler plant is running at 75 percent, that is to say for every 100 parts of coal put into the surface 75 parts are actually used in generating useful steam at the stop valve, is a popular fallacy which apparently nothing will ever kill. The average boiler plant efficiency throughout the world, including—in addition to the boilers—feed-water economizers and superheaters, is less than 60 percent. I am stating this from some considerable experience, as I have made here in Great Britain a very elaborate investigation, spread over 15 years, of over 400 different boiler plants, comprising 1,515 boilers in 41 different industries, with a total coal bill of about 3,250,000 tons per annum, and the exact net average figure of these investigations is 58 per cent, including—as already stated—feed-water economizers and superheaters. The ordinary small plant is probably less than 55 percent, and if it has no economizers and superheaters, as shown in your illustration, then it is with any reasonable output of steam something in the nature of 50 percent.

The popular conception, therefore, that the average boiler plant is working at 75 percent efficiency is so entirely erroneous that one is puzzled to know how it ever originated, even allowing for the enthusiastic statements of some firms who sell boiler plants. There is being burned in the world today something like 500,000,000 tons of coal per annum on stationary land boilers alone, and I should imagine that not more than about 2 to 3 percent of this huge amount is being used at 75 percent. The average electric power station, where there is every opportunity for the most elaborate care, certainly does not exceed 70 percent efficiency on its boiler plant, and there are very few stations in the world where the figure is 75 percent. Naturally I am quite aware that a few plants, especially with the latest type of pulverized coal equipment and in a less number of cases with mechanical stokers, are running as high as 85 percent, while one or two plants will eventually be 90 percent, but these are entirely exceptional.

Further, I may say that with regard to the illustration there is no mention made whatever of the auxiliary steam used by the boilers. For example, every plant has to have a boiler feed pump, which takes steam, and in averages anything from 1 to 10 percent of the steam generation may easily be swallowed up in this way by means of mechanical draught, steam nozzles, feed pumps, economizer scraper engines, mechanical stoker drive, and similar appliances.

David Brownlie.

Help the Traffic Cop

RECKLESS motorists beware! Marshal Schwegler of Minden, Iowa, says that he liked Mr. Slauson's article on "A New Plan for Traffic Laws." We have secured a photograph of the marshal and his motorcycle for the benefit of our readers who may come within range of his eagle eye!

His warning follows:

"I read your article in regard to the new traffic laws. I am interested in traffic laws myself as I have been an officer now for twelve years and am driving a Harley-Davidson motorcycle. . . I would like to see a law passed in every state in the Union to have the governor

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sealed on every automobile so that a car could not go over twenty-five miles an hour, except officers' motorcycles, sheriffs' cars, state inspectors' cars or racing cars on tracks. . . Another law I would like to see passed is one compelling every car owner to pass an examination before he is permitted to drive a car on the highway.

Marshal Schwegler has some splendid ideas for motor vehicle laws

"I have been reading the Scientific American for many years and I think it is the best magazine I have on my desk. I get a real kick out of this paper."

Was There a Masonic Order 800 Years Ago?

A curious photograph was sent in the other day, bearing the inscription "Masonic-like Emblem." The picture interested us and we wrote to Frank Pinkley, Superintendent of Southwestern Monuments, at Crown Point, New Mexico, to learn what we could about this find. We received the following answer. Maybe you can tell us whether a square and compass was intended.

Crown Point, New Mexico.

My Dear Mr. Munn:

In Mr. Pinkley's absence I am replying to your letter of April 16th, regarding the so-called Masonic Emblem found at the Casa Grande Ruins. . .

If you are interested in prehistoric Masonry on the American continent you will be interested in the age of this object which is carved of shell. . . Mr. Pinkley has no doubt but that it is at least 800 years old. This estimate is based on the fact that it was found four feet deep in a trash mound of the "old red" period. By this is meant that it was made, used, broken and thrown into this trash heap before black and white decoration was used by this culture, and we can trace this black and white ware back at least 800 years, which gives the minimum date to this emblem. . .

Courtesy of the National Park Service of the Dept. of the Interior

Masonic-like emblem unearthed in the Casa Grande National Monument

Masons find several Masonic points in this article. As to whether or not it was intended for a square and compass is for each observer to judge as Mr. Pinkley makes no claims as to that point.

Edna T. Pinkley,
Writing for Frank Pinkley,
Superintendent, Southwestern Monuments.

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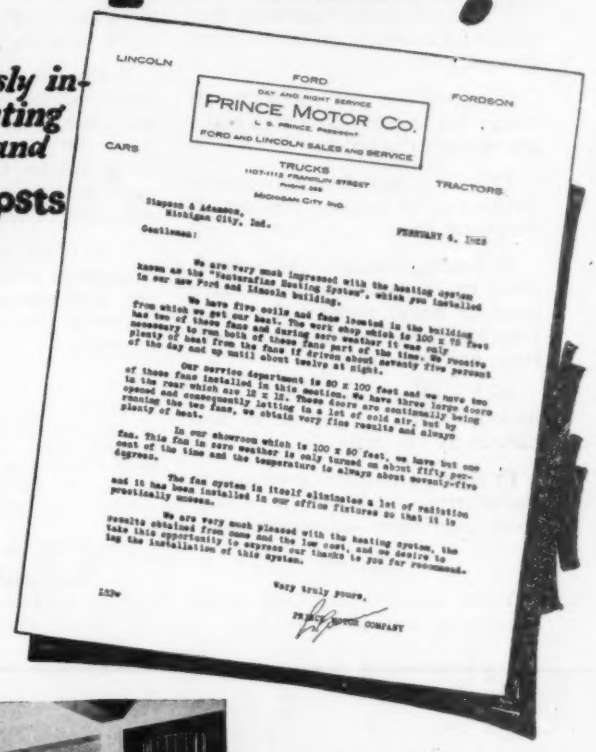
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Slagsvol & Johnson,
Michigan City, Ind.

Gentlemen: FEBRUARY 6, 1925

We are very much impressed with the heating system known as the "Venturafin Heating System", which you installed in our new Ford and Lincoln building.

We have five coils and fans located in the building from which we get our heat. The work shop which is 100 x 70 feet has two of these fans and during zero weather it was only necessary to run both of these fans part of the time. We receive plenty of heat from the fans if driven about seventy five percent of the day and up until about twelve at night.

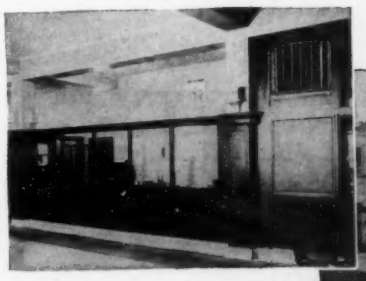
Our service department is 80 x 100 feet and we have two of these fans installed in this section. We have three large doors in the rear which are 12 x 12. These doors are continually being opened and consequently letting in a lot of cold air, but by running the two fans, we obtain very fine results and always plenty of heat.

In our showroom which is 100 x 50 feet, we have but one fan. This fan in zero weather is only turned on about fifty percent of the time and the temperature is always about seventy-five degrees.

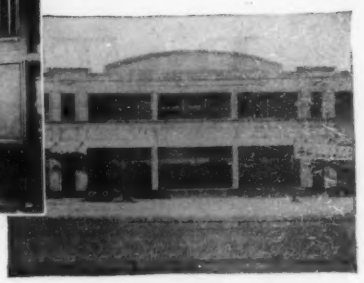
The fan system in itself eliminates a lot of radiation and it has been installed in our office fixtures so that it is practically unseen.

We are very much pleased with the heating system, the results obtained from same and the low cost, and we desire to take this opportunity to express our thanks to you for recommending the installation of this system.

Very truly yours,
PRINCE MOTOR COMPANY



This Venturafin Unit in the upper right heats a room 50 x 100 feet— note the compactness of this unit.



This Ford Sales and Service building is heated throughout with the Venturafin Method of heating.

The Venturafin Method of Heating has already been installed in buildings of all sizes and descriptions and the results have been amazing.

The above letter from the Prince Motor Co. is but one of the many testimonials proclaiming the remarkable success of this new and greater heating method.

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Also—

THIS manufacturer will make something for someone else to sell; forged of steel or any other metal shaped when hot, in pieces weighing from four ounces to eight pounds.

Being specialists in the metallurgy and heat treatment of steel, our clients know how to select steel for a given purpose and bring out its best qualities. For example: increase of strength with reduction of weight.

This plant now machines parts in quantity production so that they are interchangeable within the limits of five one-thousandths of an inch.

WRITE us about specialty you may wish to sell outright; or article in steel or other metal which you want forged, ground and either polished or gun metal finished, or painted. We will arrange meeting with manufacturer.

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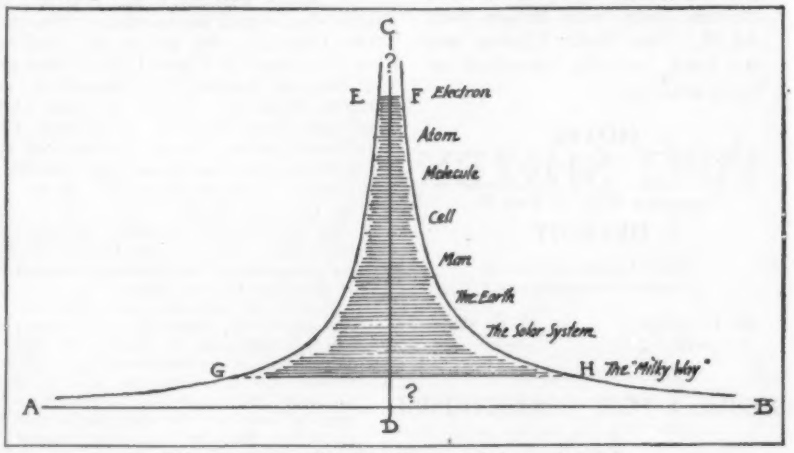
A Graphic Picture of the Universe

HERE'S something from Mr. Dercum regarding our universe—a subject most of us are a little hazy about. He offers a novel theory. Do you agree with him?

"The recently developed theory that the Andromeda nebula lies without the milky way, beyond the limits of what was our assumed universe, being itself a milky way on its own account, increases the known range of that universe tremendously. That it and the other nebulae under observation may be merely correlated parts of some outer system, staggering in its dimensions, is not a fanciful assumption.

"At the other end of scientific research chemists and physicists are battering at the elements. The conception of the cell, the molecule and the atom having been extended in turn to include further subdivision until today even the lay mind readily grasps the idea of electrons revolving about a center or about each other. That these in turn may be conceived as having their satellites or as being otherwise subject to division or analysis is again not a fanciful assumption.

"This entire progress to date, in human knowledge, along the lines above indicated, can be graphically represented by two conics. As the limits of knowledge are extended beyond the electron and beyond the milky way, as new theories and new facts develop, the figure will include them. The universe itself seems to be completely represented in this figure; complete as far as we know it, complete as far as any possible advance in human knowledge may show it, complete as it stretches beyond even the outer edges of limitless space.



Do you agree with this theory of the universe?

"A B and C D being axes extended according to the needs of the figure, draw the hyperbolas E G and F H, which approach but never touch the axes.

"Any arbitrary horizontal portion of the figure thus formed, such as the shaded area, may be said to represent the known universe at some particular time. Thus E F may represent our knowledge of the electron and G H our astronomical knowledge today. This shaded area is being constantly extended in both directions. Yet G H, in order to be all-embracing, need never quite touch the axis A B, infinity, and E F may be contracted to represent the last subdivision of the electron's complicated organism, yet still allow for infinite future contraction.

"The figure holds without revision until the crack of doom."

H. Dercum, Cleveland.

Do You Agree with This Reader?

HERE'S a kick. This reader does not agree with us on the relative value of land, water and air defense. We always like to get the other man's point of view. It produces stimulation of thought. Ideas which differ from ours are especially welcome.

123 Lyons Avenue,
Newark, New Jersey.

Gentlemen of the Scientific American:

I hope you will live to regret the stand you have taken regarding the relative values of land, water, and air defense.

It is true that aviation is not well enough developed at present to take over the national defense, but it is my opinion that there should be an Air Secretary in the President's cabinet whose duty it would be to facilitate the development of aviation in all its phases, civil and commercial as well as military.

Let us assume that we have an air force representing an outlay of money equivalent to one first-class battleship with its complement of smaller boats. The number—one thousand planes—that was used in the Congressional discussion seems conservative.

Is it unreasonable to assume that the proportionate outlay in land bases and repair facilities for Air and Navy would be nearly equal?

Let us assume that most of this fleet is engaged in civil and commercial transportation, the pilots receiving military training for a short period each year, and the fleet subject to call in case of emergency. This earning capacity should bring the cost of maintenance to a very reasonable figure.

Now I will purposely make this picture in black as I can conceive it. We assume a fleet of only one thousand serviceable planes, and we will suppose we have no Navy. Even so, if we are attacked by a nation having a navy exactly equal to our present naval defense, having the same number of planes as ours now has, could they land troops or even bombard our coast with reasonable safety?

The picture is unreasonable. The number of planes is altogether inadequate to the size of the country, but very effective in an emergency.

Few, if any, people of influence entertain any idea of abandoning the Navy. But I believe that some defense money could well be directed to aviation purposes, and that with administration as honest and efficient as we now find in the Navy, we would get more defense for our money.

I hope there will be lots of discussion of this subject, and that someone more capable will take up my point.

I appreciate your aviation department. May it grow to much greater proportions! And may the new investment column have a long and useful career.

Laurence S. Monson.

Congratulations!

BORN the same year as the Scientific American, and a subscriber nearly all that time—surely that is a record of consistency. Thank you, Mr. Bristol, for your good wishes, and permit us to extend ours.

New York City.

Dear Mr. Munn:

It is with great pleasure that I return memorandum card received with your recent progressive letter pertaining to Scientific American Home Service.

I congratulate you upon that letter and its enclosures. Kindly find my card herewith.

Incidentally, I may state that I believe the Scientific American made its first appearance in 1845, the year of my birth, and it seems to me that I have been a subscriber for pretty nearly all that time.

With kind personal regards and all good wishes.

John I. D. Bristol.

Engine Balance

The Conclusion of Professor Cormac's Discussion of Counterbalance

By P. Cormac, F.R.C.Sc.I.

IN our July issue, we considered single and multi-cylinder engine balance. The application of the two-circle method to radial and V engines will be shown in the analysis of the balance of the eight cylinders set at right angles, the rods of corresponding cylinders sharing the same crank-pin. The crankshaft is the usual flat four cylinder type. For the V engine a separate diagram is drawn for the cylinders on the right and on the left side of the engine. These are shown in Figure 1. The crankshaft is set out so that it is on the dead center for the right bank of cylinders. The equivalent rotating masses are shown on the circles, the Roman numerals indicating reverse rotating masses.

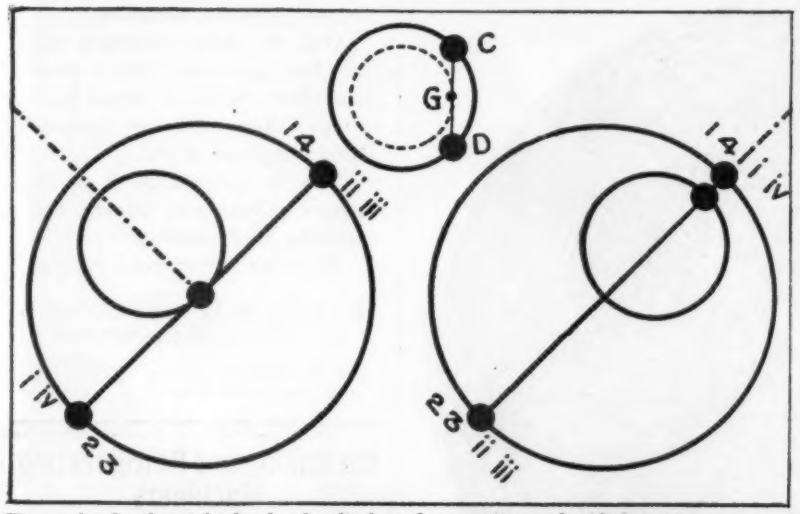


Figure 1: In the right bank of cylinders the rotating and unbalanced masses are in line, as the crankshaft is set on the dead center. In the left bank—the crankshaft being at 90 degrees—the masses are again in a straight line. The components of the unbalanced masses, however, of the two banks resolved in the pilot diagram, show the ultimate unbalanced mass at G. This is the mass to be counterbalanced

It may be noted that if the circles were folded along the dotted cylinder-center line, the corresponding Arabic and Roman numerals, representing the direct and reverse rotating masses for each piston, would coincide. This is helpful in marking in the positions of the reverse rotating masses.

The secondary circle of each group shows all masses concentrated at a single point. It is clear that all the masses running on the primary circles are in balance. The two secondary circles with the masses running on them are redrawn with a common center in the pilot figure above. The direct and reverse secondary masses for the right bank of cylinders fall at the upper right hand point of the secondary circle and are shown at C on the pilot diagram. The direct and reverse secondary masses for the left bank of cylinders fall at the lower right hand point of the secondary circle and are shown at D on the same diagram.

Evidently these secondaries are not in balance, for the center of gravity of the direct rotating masses is at G as is also the center of gravity of the reverse rotating masses. In fact the system is equivalent to direct and reverse rotating masses of the same amount at G rotating in the dotted circle through this point, and these again correspond to the secondary balance masses of a piston oscillating in a horizontal direction.

As the radius of the dotted circle is one-half times the radius of the secondary circle, the secondary inertia force of an eight-cylinder V engine with a flat crankshaft is 8/22 times the secondary force of one of its cylinders. This force tends to vibrate the engine in a horizontal direction. For an engine having the cylinder dimensions and speed already given, the horizontal vibrating force reaches 2,085 pounds weight.

The superiority of an eight-cylinder V engine having a crankshaft with complete primary and secondary balance will now be appreciated. Such a crankshaft, shown in

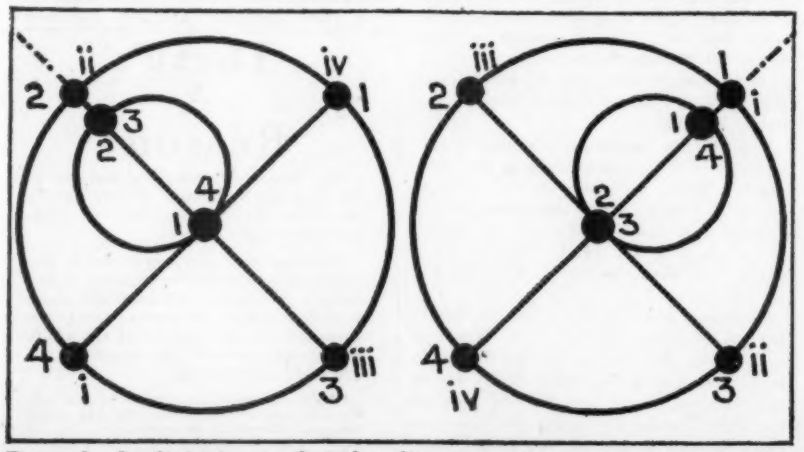


Figure 2: In distinction to the other diagram on this page, and those which appeared in the first part of this article in our July issue, it will immediately be noticed how the centers of mass of the various reciprocating parts are distributed over the diagram, showing at once that less counterbalancing will be necessary in the straight-eight engine

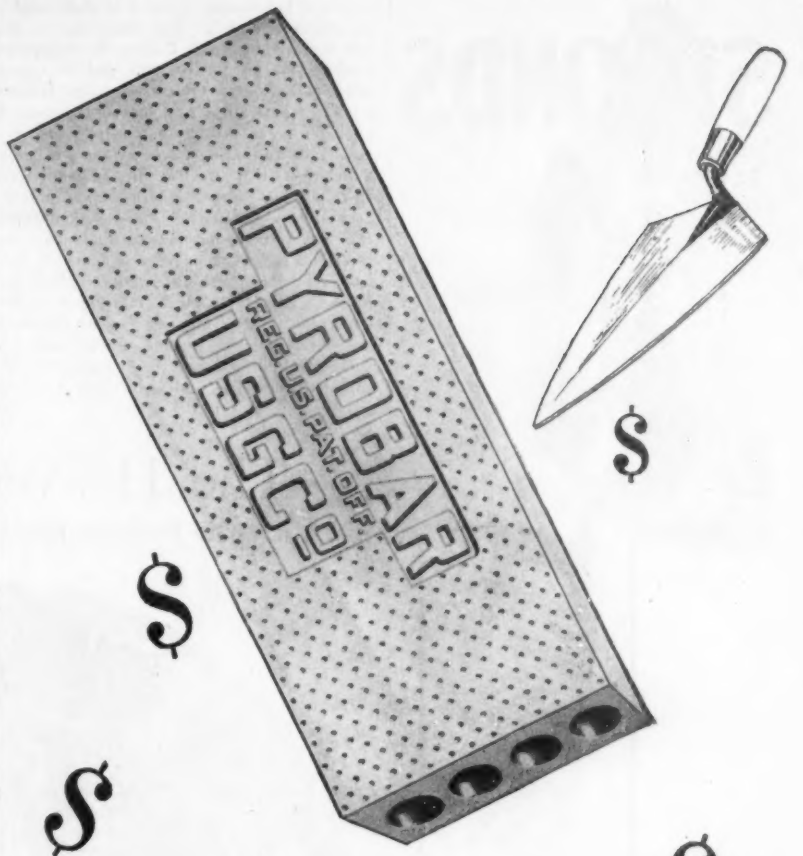


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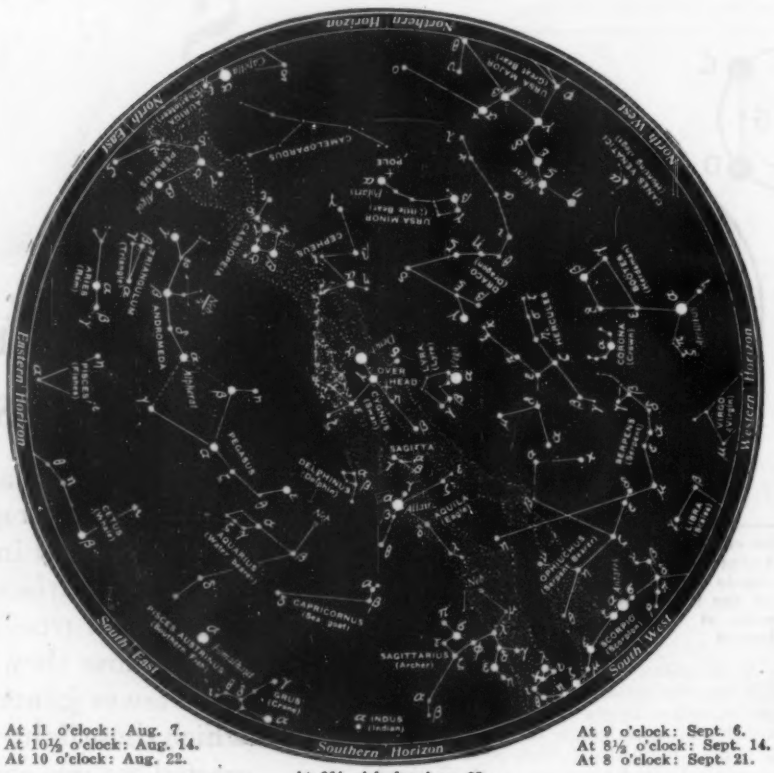
Figure 2 has cranks 1 and 4 at right angles to cranks 2 and 3. The diagrams on left and on right in Figure 2 show the equivalent rotating masses for the left and the right bank of cylinders respectively, the Roman numerals indicating reverse rotating masses as before. It will be noted that the secondary circle masses are in balance, it being understood that the Arabic numerals on these circles represent both direct and reverse rotating masses. Also on combining the two primary circles we find that the reverse rotating primary masses are in balance. The only unbalanced effect is that due to the masses 1, 3, 4, 2, rotating with the crankpins. These, however, can be balanced by counterbalance masses placed opposite each crankpin so that the design gives us complete primary and secondary balance. This is the type of shaft used in the Cadillac V-63.

For every type of engine the connecting rod can be dealt with by considering it broken into two parts of masses proportional to the distances of its center of gravity from its ends. The heavier portion is assumed to be as it were part of the crankpin, and the lighter portion is assumed to be part of the piston. This replacement is exact as far as balance of inertia forces is concerned, and it is but very slightly in error for other calculations. No particular advantage is obtained by making the rod so that it has the same period when oscillated about either the big or the small end. In this case, however, the replacement into two parts at the crankpin and gudgeon pin is exact for all kinds of balancing calculations.

The Heavens in August

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

OUR map this month shows the summer skies as they would appear to one lying on the ground, with his feet to the north, and looking straight up. Right overhead is the great cross of Cygnus in the Milky Way. To the west is Lyra with the bright star Vega, to the south Aquila with Altair. Arcturus is low in the west, and Hercules and Corona are between it and Vega. Ophiuchus and Serpens are in the southwest and Scorpio is setting there, while Sagittarius, brightened by the presence of Jupiter, is just west of south. The southwestern sky is dull—the only bright star there being Fomalhaut. Pegasus is in the east. Andromeda, Perseus and Cassiopeia in the northeast. Ursa Major low in the northwest and Ursa Minor and Draco above it.

The Planets

Mercury is an evening star at the beginning of August and sets at 8 P.M. He is easily visible in the twilight for the first few days of the month, but then draws in toward the sun. On the 21st he passes through conjunction to appear next month as a morning star.

Venus is an evening star, too, and is close to Mercury when the month begins; but she is moving away from the sun, while he is speeding toward it, so that they soon draw apart. She is, however, moving southward and her time of setting is about 8 P.M. all through the month.

Mars is an evening star too but is much nearer the sun than the others and is practically invisible.

Jupiter is in Sagittarius just past opposition and well observable till long after midnight. Saturn is farther west, in Virgo, and is an evening star, setting about 10 P.M. Uranus is in Pisces, and comes to the meridian about 2 A.M. while Neptune is in conjunction with the sun on the 15th and is invisible.

The moon is full at 7 A.M. on the 4th, in her last quarter at 4 A.M. on the 11th, new at 8 A.M. on the 19th, and in her first quarter at midnight on the 26th. She is nearest the earth on the 4th and farthest away on the 17th. During the month she is in conjunction with Jupiter on the 2nd, Uranus on the 7th, Neptune on the 19th, Mercury and Mars, on the 20th, Venus on the 22nd, Saturn on the 25th, and Jupiter again on the 29th.

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Science and Money

Research Decreases Cost of Electricity

Technical Development Affects Earnings and Security Values of Electric Light and Power Companies

By Chase Donaldson

ELECTRIC power plants of today are economical beyond the most optimistic hopes of the early engineers. Merely the size of the modern machines and the cathedral-like spaciousness of the stations themselves would startle the pioneers in electrical science. Even those to whom the busy hum of turbines is familiar music cannot help but be impressed by the 100,000-kva. turbine that Westinghouse is now building for the Brooklyn Edison Company.

Size alone has not effected all of the economies that have been realized thus far in the production of electricity. Of equal importance have been the effective utilization of the heat units in the coal, high efficiency in the conversion of steam to electricity, thorough protection against electrical breakdowns, and the transmission of electricity with the minimum loss.

Coal

Power plants are placed as close to the coal mines as the supply of water for cooling purposes will permit, and coal-handling apparatus has become almost unbelievably mechanical. The two-armed crane that straddles a belt conveyor at the new Philo (Ohio) plant of the American Gas and Electric Company hustles coal around in a most uncanny fashion.

Automatic stokers, of course, have been in operation for many years. Now a more refined method of feeding the coal to the boilers has appeared in the pulverized fuel-burning equipment which is being adopted for many of the newer plants. The Milwaukee Electric Railway and Light Company, the Duquesne Light Company, the Puget Sound Power and Light Company, the West Penn Power Company, and the Cleveland Electric Illuminating Company, to mention but a few, all have some powdered-fuel installations. It is claimed that these installations realize efficiencies from 83 to 86 percent as against stoker efficiencies of around 76 percent. With this equipment, in spite of variations in the grade of fuel used, a high boiler efficiency can be maintained and a great flexibility secured.

Larger and better designed combustion chambers, refractory linings with a longer life, improved baffling arrangements, inclined and stepped grates, and more effective forced and induced draft apparatus—all have had a hand in increasing combustion efficiency.

The index of this increased efficiency is the pounds of coal consumed per kilowatt hour of electrical output. In 1919 it required 3.22 pounds of coal, or its equivalent in other fuels, to produce a kilowatt hour of electricity. In the year 1924, this figure stood at 2.18 pounds of coal, less than 68 percent of the 1919 rate. Measured in dollars, this gain in efficiency means a saving of approximately $113,000,000 in the year 1924 alone, assuming coal at $4.

Steam

In the turbine room, economies have been effected through the use of higher steam pressures, temperatures, and degrees of superheat, bleeding the turbines for feed water heating, and reheating the exhaust steam to pass it through the lower pressure stages again.

Steam pressures ranging from 300 pounds per square inch up to 550 pounds are common practice, and one or two installations are promised at 750 pounds pressure. At the Weymouth plant of the Boston Edison Electric Illuminating Company a 1,200-pound turbine exhausting into headers to supply other turbines with steam at lower pressures is now in successful operation.

Mercury turbines have been installed so far at but one plant, that of the Hartford Electric Light Company, but it has been rumored in technical circles that one of the largest stations now on paper will make some use of the mercury equipment. The first mercury boiler and turbine installation has been fully described in the February, 1924 issue of the Scientific American.

Condensing apparatus has been measurably improved within the past few years, and has helped to insure continuous turbine operation. Feed water purifiers now insure a clean supply of water for steam, and longer life for the boiler tubes and turbine blades.

Electricity

Breakdowns, of course, run up the cost of operation out of all proportion to the costs of normal operating conditions. Effort in central station and electrical design has been directed most strongly towards reliability of service.

In the more recent plants, each operating unit is segregated from its fellows to prevent everything "going out" at once. Conduits are now run in separate ducts, and conduit rooms are well insulated from the rest of the plant.

Entirely distinct switch houses carry the heavy-duty switching equipment, and each switch is usually a unit in itself, well insulated from the others.

Reactors to limit trouble that may occur on feeder lines and busses have been used more extensively in the later designs.

Automatic devices throughout the power plant and in substation operation have done much to eliminate the labor element and to safeguard against breakdowns.

Operations

Operating ratios have been measurably improved over the past few years as a result of all the technical improvements that have been passed in review in the preceding discussion. And lower operating ratios naturally mean larger net profits from operation. Of course, the electric light and power companies are under the jurisdiction of the public service commissions, and are regulated as to rates, kinds of service, and net return on property value. But these commissions have shown a greater tendency to allow the more efficient utilities some credit in the rate of return. The better part of the operating economies, however, has been reflected in the rate reductions that have been made, and in the steady rates that have been maintained in the face of rising costs.

Securities

But the investor is more interested in the actual securities than he is in all the technical features that make for better earnings and service. Nevertheless, it is evident that the relationship to security values is indeed direct. The engineers behind the electrical industry are most progressive and may be depended upon to continue attacking operating costs through research and experiment.

Considering that the electric companies are in a period of prosperity, and that the individual use of electricity is increasing year by year, the investor need not hesitate to buy the common stocks, preferred stocks, and bonds of the better managed and established companies. The bonds are probably as good a buy now as they may be at a later date, but the common stocks have enjoyed such a rise within recent months that it may be wise to wait for a reaction.

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Courtesy of General Electric

Chester W. Rice (left) and Edward W. Kellogg working on new hornless loudspeaker unit

New Hornless Loudspeaker Described by Inventors

A HORNLESS loudspeaker of new design has been invented and demonstrated by two research engineers of the General Electric Company, C. W. Rice and E. W. Kellogg.

The new instrument operates on the principle known as the moving coil type drive. If a copper wire is placed between the poles of a magnet the wire is pushed sidewise when an electric current is sent through the wire. It is this phenomenon which causes the armature of an electric motor to rotate, and in this loudspeaker the same action gives the desired back and forth motion to the diaphragm.

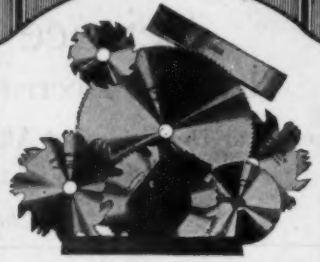
The inventors described the instrument as follows: "The wire is wound into a coil, and since it moves parallel to the face of the magnet poles instead of toward and away from them, there is no limit to the distance it can move. The varying currents from the radio set are passed through an amplifier to the moving coil. The strength of the magnetic force on the coil of copper wire varies with the current, and the coil is thus caused to vibrate. The moving coil is attached to the diaphragm, a paper cone about six inches in diameter.

"An important feature of this loudspeaker is the baffle board which surrounds the diaphragm and which serves as the front of the cabinet. The baffle does not radiate sound, but it prevents air from circulating between the front and back of the diaphragm. The use of the baffle makes it possible to dispense with horns without sacrificing the radiation of the deeper tones. The edge of the paper cone or diaphragm is attached to the baffle by means of a thin rubber. As a result of this extremely flexible support the diaphragm resonance corresponds to a tone so low that it can hardly be heard.

"The cabinet contains, in addition to the speaker itself, a rectifier and amplifier, power for the operation of which is taken from the alternating current lighting circuit. The amplification is sufficient so that in the case of local stations, clear loudspeaker reproduction can be obtained from a crystal, provided the latter gives clear headphone reception. It is important that the amplifier used be designed to have ample capacity, since the extension of the range of response of the loudspeaker to higher and lower tones makes defects in the remainder of the system more noticeable, particularly roughness of tone due to overworked amplifiers."

Wide World

The joys of radio have penetrated to the storm-beaten country of Russia. Our photograph shows a father and son, radio fans in the village of Vologda. The father, by right of seniority, enjoys the concert while the son waits his turn



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Fotogram

"Sadie," one of the star performers for a big tent show, stopped long enough from her labors to say something into the microphone. It would be interesting to know just how her efforts were received by the listeners!

New Class of License for Station Operators

A NEW class of operator's license has been established by the Department of Commerce for operators of radiophone broadcasting stations. In order to pass the code test the applicant must be able to receive the Continental Morse code at the rate of twelve words a minute, counting five characters to a word. This is much slower than the regular commercial operator is required to copy. The theoretical part of the examination consists of questions dealing with broadcast transmitters, receiving sets, storage batteries, motors, generators, and the laws governing radio communication. The passing mark is 75 percent.

If the applicant has had three months' service at any class of commercial station, including a radiophone station, full credit of 20 percent is given for the experience. Fifteen percent is granted to holders of commercial licenses who have had no actual commercial experience. The same advance credit is given instructors of recognized radio schools and colleges and to operators who have had only experience at Federal Government stations not handling general public service. Ten percent credit is granted to graduates of radio schools and holders of amateur first-grade licenses. Holders of amateur second-grade licenses and correspondence-school graduates get five percent credit.

Questions used in the examination can be obtained by radio supervisors at their various offices throughout the country. The regulations provide that operators holding special extra first-class, first-class, or second-class licenses can operate broadcasting stations.

Engineers Say Super-power Era Has Not Yet Arrived

THE era of super-broadcasting has not yet arrived if a super-plant is one capable of radiating 50 kilowatts or higher. The highest power reported to have been used by a broadcasting station in the United States was 10 KW, and that was on a special occasion. During the past year a number of stations have installed 5,000-watt transmitters, but engineers do not consider a 5-KW station as a super-power broadcaster. Although these new transmitters are rated at 5 KW most of them are not authorized by the Department of Commerce to use more than 1500 watts. The majority of these high-power stations are located at least twenty-five miles from densely populated cities so that interference will not be too strong.

The low power utilized by broadcasting stations was recently pointed out by an engineer who used interesting comparisons. He explained that 665 kilowatts are used by a ten-car subway train, exclusive of power used for heating. WEAF uses two kilowatts and WJZ 750 watts for transmission. An electric sign at Broadway and Forty-second Street uses 263 kilowatts and many of the broadcasting stations consume less power than required to light the average home.

Amateurs Must Not Talk With Commercial Stations

D. B. CARSON, Commissioner of Navigation, has directed the following letter to all amateur station operators:

"The regulations governing the operation of amateur stations, dated December 24, 1924, paragraph under intercommunication, are amended to read as follows: 'Amateur stations are not permitted to communicate with commercial or government stations unless authorized by the Secretary of Commerce, except in an emergency or for testing purposes which may be construed to cover official Government business. No variation of amateur wavelengths is permitted, and the amateur quiet-hours restriction must be observed. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats, which may have difficulty in establishing communication with commercial or government stations.'"

Ship's Radio Apparatus Not Subject to a Lien

RENTED radio apparatus on board a ship is not part of the vessel, and, therefore, may not be subject to a lien on the ship, according to a decision recently handed down by Judge Bledsoe in the District Court for the Southern District of California. Radio interests engaged in marine communication have long sought a definite ruling concerning the right to subject a ship's radio installation to claims against vessels so equipped.

The action in which the decision was made was filed against the British yacht *Frontiersman*, on which the Marconi Company had installed and rented apparatus for radio communication purposes. The Marconi Company was the intervenor in this suit. The court held that the apparatus did not become a part of the ship, and, therefore, was not subject to libel against the vessel. The case is said to be the first of its kind in American jurisprudence. The decision is considered of considerable importance in radio circles inasmuch as thousands of dollars are now invested in radio installations on board ships.

Would You Like An Oil Painting Of an S. A. Cover?

Each month the Scientific American receives from numerous art-loving subscribers letters expressing appreciation of the cover picture. Some readers express a desire to purchase the original valuable oil painting from which the cover illustration is reproduced.

Obviously, it is not possible to gratify the wishes of all these admirers, much as the Scientific American would like to do so. The editors, however, have decided to give to friends of the magazine three oil paintings, the originals of the covers for May, June and July.

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I have your letter of recent date in which you ask me as to the results obtained from our campaign on "COMMERCIAL" Annular Ball Bearings.
Of course, the underlying policy back of this campaign was not so much the intent to obtain inquiries as it was an effort to give greater publicity to a bearing which is very widely used in hundreds of different industries. I was, therefore, not only gratified, but very much interested to find that although the copy did not specifically call for inquiries, a great many letters were received asking for samples and quotations.
There is no doubt in my mind but that SCIENTIFIC AMERICAN appeals particularly to manufacturers, engineers, and purchasing agents, who are constantly in the market for a product such as we manufacture.
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5 shot using the U. S. Army caliber 30, Mod. 1906 cartridges. Weight, 8 pounds. Length, 42¾ inches; barrel, 23 inches. Turned down bolt handle. Special price, $10.45. Ball cartridges, hard nose, $2.50 per 100. Web cart. Belt, 40 cents. Tents, cots, Messpans, canteens, Knapsacks, haversacks, Outing Suits, hats, helmets, Saddles, bridles, Bugles, lariats, Medals, etc. 16 Acres Army Goods. New Catalog 1925, 60th Anniversary issue, 372 pgs., fully illustrated, contains pictures and historical information of all American Military guns and pistols (incl. Colts) since 1775, with all World War rifles Mailed 50c. Est. 1865. Spec. New Circular for 2c stamp.
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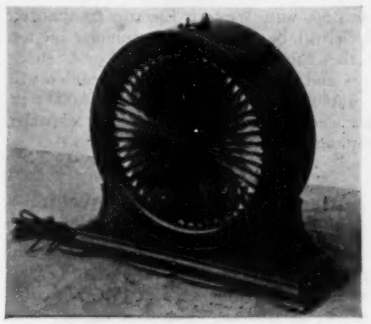
Clock-shaped Loudspeaker

The Victor Talking Machine Company has produced a new loudspeaker shaped like a mantel clock, in which the dial is replaced by an amplifying diaphragm, and the works by an electrical speaker unit.

The diaphragm used for sound amplifications is new on the American market, and is made under an exclusive license with the inventor, L. Lumiere, of France. It is specially treated parchment paper pleated and assembled around a central core to form a nine-inch disc of maximum sound radiating surface. Two such diaphragms are used; one at the front actuated by the electrical unit, and a secondary balancing diaphragm at the rear acting in a loading and resonating capacity. Both diaphragms are spring mounted in the cabinet rings, and form with the case a drum-like assembly.



The Victor loudspeaker equipped with amplifying diaphragm and electrical speaker unit

The method used in constructing the Lumiere diaphragm is to take a strip of parchment paper of approximately half the diameter of the resulting diaphragm in width, coating it with protective asphalt and running it through a crimping machine. The strip is then cut to exact length, so that the unfolded length is equal to the circumference of the resulting diaphragm. The ends are cemented together to form a band. The diaphragm is then assembled around a paper core, and cemented to it.

Both diaphragms are spring mounted in the wooden dial rings of the speaker, so that any slight change in the diaphragm, or the case, tends to be self-adjusting.

The electrical unit is so designed that the impedance increases with the increase in the cycles of the applied current. By the relation thus established, it is claimed that the impedance of over-musical range, balances the impedance of the vacuum tubes common to the American public.

The distance between the pole pieces and the armature is adjustable, to meet the requirements of heavy imput from local stations; or react to feeble excitation from distant stations.

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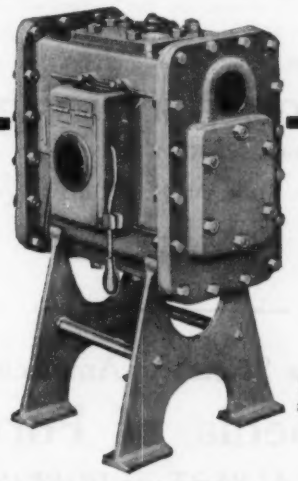
This large **Re-Set Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra. (*Cut less than half size.*) Set-Back *Revolution* Counter, $10. (List.)

The Veeder booklet is an 80-page guide on how to register an increased production at ANY machine. Sent free to all who may meet with the problem—in invention, engineering or manufacturing.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.



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Latest Station in Michigan Has an Output of 5,000 Watts

STATION WJR, the Jewett Radio and Phonograph Company's new broadcasting station at Pontiac, Michigan, is now on the air. It is a 5,000-watt transmitter designed by the Western Electric Company. The apparatus is connected with studios and remote control stations in Detroit by thirty miles of telephone wire. The site of the station has proved excellent for obtaining an ideal ground system. A lake comes up almost to the edge of the 200-foot towers and between the two masts and stretching down into the water is a net work of more than eleven miles of copper wire laid at right angles to the antenna.

New Transmitter for WSB

STATION WSB, Atlanta, has purchased a new 2,500-watt Western Electric transmitter, which will be installed this summer on top of the Atlanta Biltmore Hotel. A sharp wave and the elimination of harmonics will be obtained by the use of a new 4,000-watt water-cooled amplifying tube and capacity coupling.

International Radio Bureau Established at Geneva

THE many international problems pertaining to broadcasting caused European stations to hold a conference at the *Palais des Nations*, at Geneva. Fourteen nations sent delegates to the conclave and the outcome was the immediate establishment of an international bureau to deal with all matters that affect the broadcasting companies and listeners of more than one country.

Arthur Burrows relinquished his duty as program manager of station 2LO, London, to manage the office of the bureau at Geneva. His office will be a direct channel for the interchange of programs, regulations, ideas, and all matters of interference, among the broadcasting stations.

The aim of the new bureau is to establish an effective link between the various European broadcasting stations, keeping in view the possibility of activities being extended to other continents; secondly to defend all policies and measures affecting stations' interests; thirdly to centralize the study of all questions arising from the rapid development of wireless telephony, and finally, to initiate and further all efforts toward the improvement of broadcasting generally for the benefit of all nations, individually and collectively.

The bureau intends to make a feature of relaying concerts from one country to another. It also plans for the interchange of programs, and entertainers.

CKAC Radiates Information for Motorists Near Montreal

RADIO-EQUIPPED motorists in the vicinity of Montreal this summer get from CKAC, daily road reports and information regarding points worth visiting. J. L. Perron, Minister of Roads for the Province of Quebec, made arrangements with the broadcaster to send out at intervals each day all information of value to automobilists. The broadcasts contain a general guidance for motorists, short cuts, bridges and roads being repaired and location of camping grounds.

The items are put on the air at 4:00 P.M. daily and at 8:30 P.M., Eastern Standard Time, Tuesdays and Saturdays. Fifteen-minute talks by provincial government members tell the advantages of each locality from the tourists' point of view.

Radio Congress Approved Short Waves for Amateurs

THE success of amateur stations in sending short-wave signals from country to country led the International Radio Congress, recently held in Paris, to approve a series of recommendations relative to specific wavelengths to be assigned amateur transmitters. The world was divided into four sections for the purpose of assigning the short-waves—the United States, Europe, Canada and the rest of the world. The waves decided upon were:

United States—85-75 and 41.5-37.3 meters.
Europe—115-95, 75-70 and 47-43 meters.
Canada—120-115 and 46-41.5 meters.
The rest of the world—96-85 and 37.5-35 meters.

Lower Waves May Be Assigned to Class B Broadcasting Stations

THERE are now 95 Class B broadcasting stations. Every available channel in the wavelength band assigned to this type of station is in use. A discussion between the Department of Commerce and the National Association of Broadcasters indicates that the wavelength band for Class B stations may be lowered in the fall to 250 meters.

"Until the public possesses a greater number of receiving sets which will go down as low as 250 meters, we presume Class B licensees will try to avoid being allotted the proposed low wavelengths," said Paul B. Klugh, Executive Chairman of the National Association of Broadcasters.

"Unless a certain broadcasting station which is dissatisfied with its present wave allotment recedes from the position it has taken, the matter will probably land in the courts. This would be unfortunate, because under the present law Secretary Hoover is almost defenseless and is doing his best to preserve harmony. It is a hard thing to dissuade certain citizens conversant with those phases of the Constitution which guarantee equality from demanding what they believe to be their rights. The fact that the air is crowded does not interest them.

"There are two lines of fundamental reasoning as to how the use of the air should be allotted," said Mr. Klugh. "The first deals with priority, and the second with ability and fitness. The proponents of priority argue, 'Our time should not be divided. We were first and have rights.' To which those striving for a division of time retort, 'Because you were first is no proof that you are best. We propose superior equipment and programs, and in the interest of public entertainment should have part of your time.' And so the battle goes on, with the Department of Commerce struggling under its limited number of Class B air channels, manufacturers making receivers so sensitive that stations thousands of miles apart hetrodyne, and an army of prospective broadcasters determined to break in somehow.

"There is no doubt that the next session of Congress will enact new radio legislation. It is likely that the finally amended White-Howell bill will be used as the basis. We suggest that all broadcasting stations study this matter carefully and express their opinion to this association without delay. Our representatives in Washington, backed up with such opinions, will do their best to protect the interests of broadcasters in the informal discussions now taking place."

Hamilton Has 6,000 Listeners

IT is estimated that there are 6,000 radio receiving sets tapping the ether over Hamilton, Ontario. Each owner must have a license to receive and it costs one dollar. A radio dealer at Niagara Falls calculates that there are 8,000 radio sets in use in that city.

Two Ocean Vessels Use Low-Wave Transmitters

THE French meteorological steamer *Jacques Cartier*, is equipped and licensed to use short wavelengths for transmission. The ship uses 45-meter waves in daylight and the 115-meter channel at night. She is now plying between France and the Gulf of Mexico. The British steamer *Samaria* was recently equipped with a low-wave installation for experimental work with American and British amateurs. The 20-meter wave is used in the day time and 90 meters at night. The *Samaria's* call is G6YM.

The Book Department

Below are given by subjects, some of the standard and recent books that can be recommended for clearness of treatment and understandability. We will cover two or three subjects each month. Full descriptions will be furnished on request.

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Food Analysis by Woodman..... 3.70
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Civil Engineering

Handbook of Building Construction by Hool and Johnson.....10.00
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A most interesting record of achievement covering all phases of development. Well illustrated. Chapter XII gives condensed biographies of some of the more prominent officials. Published by Bureau of Railway News & Statistics. $2.20 postpaid.

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By W. Blum and G. B. Hogaboorn

U. S. Bureau of Standards

The results of research practically applied to the whole field of commercial electro-deposition. Clear and understandable. Published by McGraw-Hill Book Co. $4.20 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

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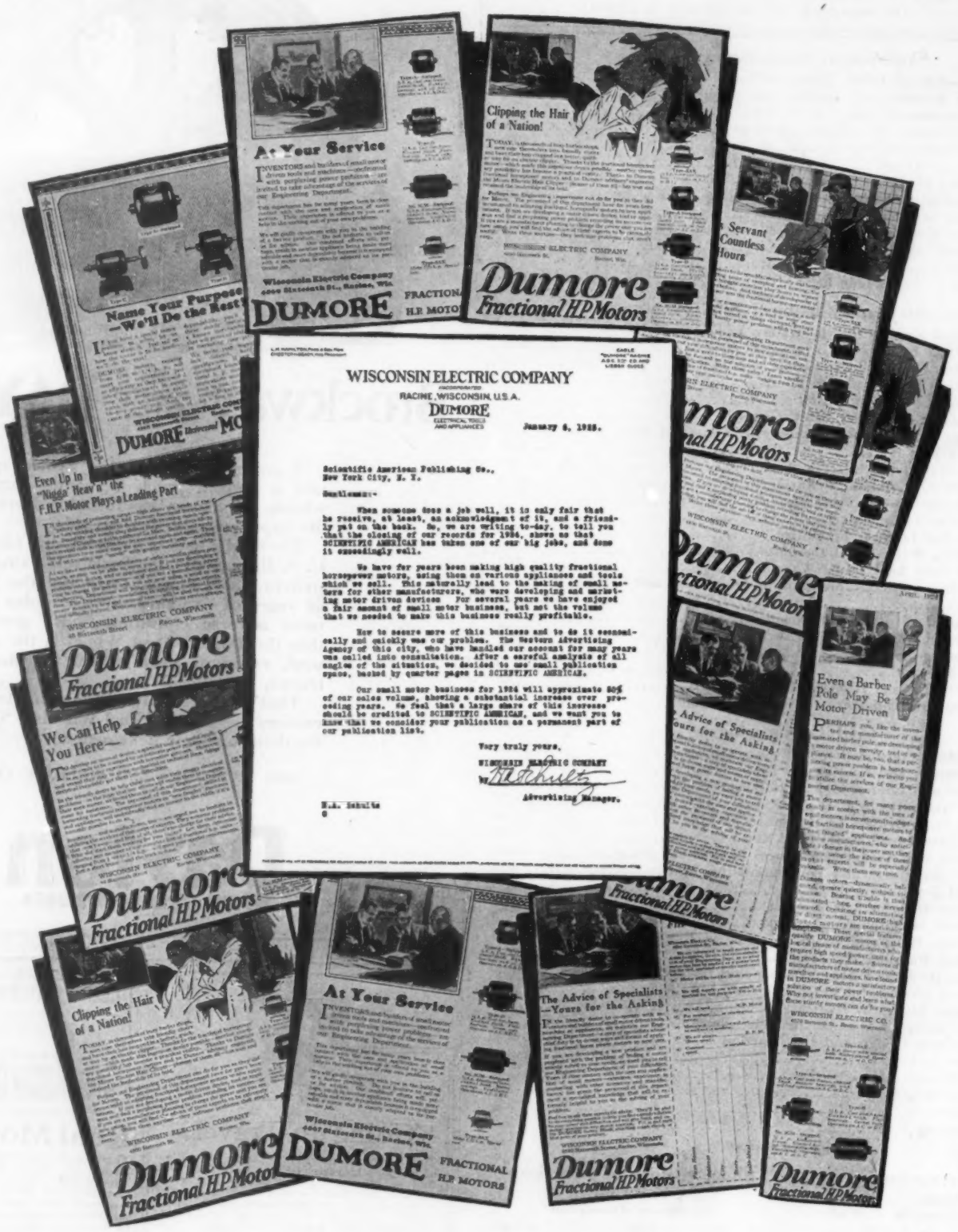
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RACINE, WISCONSIN, U.S.A.
DUMORE
January 6, 1925.
Scientific American Publishing Co.,
New York City, N. Y.
Gentlemen:-
When someone does a job well, it is only fair that he receive, at least, an acknowledgment of it, and a friendly pat on the back. So, we are writing to-day, to tell you that the closing of our records for 1924, shows us that SCIENTIFIC AMERICAN has taken one of our big jobs, and done it exceedingly well.
We have for years been making high quality fractional horsepower motors, using them on various appliances and tools which we sell. This naturally lead to the making of small motors for other manufacturers, who were developing and marketing motor driven devices. For several years we have enjoyed a fair amount of small motor business, but not the volume that we needed to make this business really profitable.
How to secure more of this business and to do it economically and quickly was our problem. The Western Advertising Agency of this city, who have handled our account for many years was called into consultation. After a careful analysis of all angles of the situation, we decided to use small publication space, backed by quarter pages in SCIENTIFIC AMERICAN.
Our small motor business for 1924 will approximate 80% of our sales volume, showing a substantial increase over preceding years. We feel that a large share of this increase should be credited to SCIENTIFIC AMERICAN, and we want you to know that we consider your publication as a permanent part of our publication list.
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Scientific American Publishing Co.
Woolworth Building New York

"Spirit Return"

(*Concluded from page 85*)

I am here, old boy" or "Gill, I love you" and so on. Neither is her very high grade of mentality highly complimented by some of the jargon that is claimed to have been transmitted directly by her in some of the long letters and poems submitted as her dictations. It is perfectly evident that the communications are limited to the mentality of the transmitter, which was usually of a low type.

What means this medley and how are we to explain the phenomena as presented by the voluminous correspondence? Most of it can be swept from the board and considered explained by automatic writing, somnambulism, positive and negative hallucinations, objectifications of the subconscious, dissociations of personality, and kindred phenomena which have long been recognized and which can be found in abundance without resort to a so-called super-normal or a *post mortem* state. The further investigation progresses, the more one feels that the so-called occult or supernormal, if properly understood, can be organized and classified under the various phases of conscious and subconscious experience, explicable on the basis of psychological principles which are well understood.

In the face of such advocates as Lombroso, Lodge, Crooks, Stead, James, Hyslop, Doyle and others, it makes one pause before he pushes the whole affair aside as unworthy of the serious attention of conscientious investigators. While, with perfect justice, we revere our scientists as our main hope in the advancement of knowledge, it does not necessarily follow that they are the most competent observers and judges in a field where fraud and trickery seem to be in the ascendency. They tend to accept what they see because nature in the laboratory is always frank and sincere anad seldom fools them. The spiritualistic field is too saturated with fraud to be trusted exclusively in the hands of those who have had an exclusively "scientific" training.

Science Notes

How Powerful an Engine Is an Athlete?

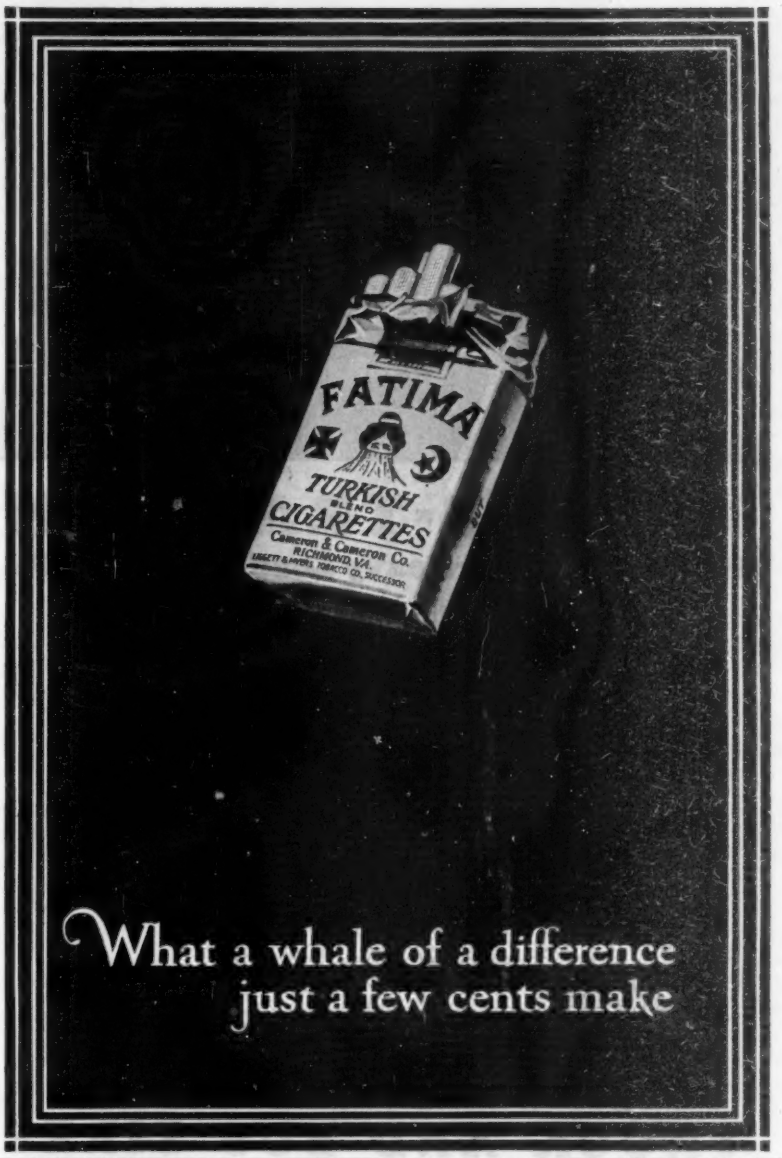
EXACT studies of the physical exertion put forth by the members of the famous Yale crew of 1924 made by Dr. Yandell Henderson and Dr. Howard W. Haggard, of the Department of Applied Physiology at Yale University, show that each man developed, during the period of a boat race, about one-half horsepower.

Determinations of the energy expended were obtained in various ways. In one test the men were exercised individually on rowing-machines with power meters attached. In another, the ratio of the amount of oxygen taken in to the amount of carbon dioxide given off in breathing was determined. In a third the racing shell which they used was towed by a power boat with a spring scale in the towline.

"The data from these three methods were in general in fair agreement," says Dr. Henderson. "They indicate that the maximal power exerted is from .45 to .55 horsepower per man, or, expressed in the heat equivalents, 4.8 to 5.9 calories per minute, with a total energy expenditure of 19 to 29 calories per minute, or 13 to 20 times the basal rate."

It was noted that, however great their exertion, these athletes did not puff and blow noticeably. This is in marked contrast with the distress of untrained or half-trained men. The amount of oxygen which the oarsmen took in through their lungs reached about the limit of the carrying power of heart and blood, yet it was not sufficient to replace the amount burned up during the race.

As Dr. Henderson expresses it, "the athlete draws heavily on his credit and incurs oxygen deficits. These deficits are repaid by the high rate of oxygen absorption for a time after the work is ended."—*Science*, Jan. 30, 1925.



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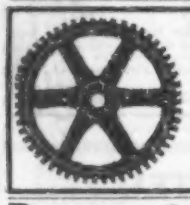

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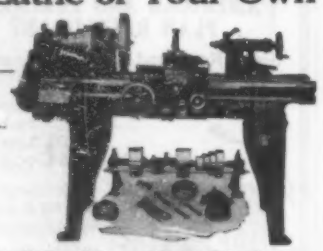

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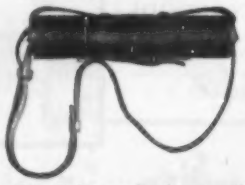

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AERONAUTICS

THE college youth has long attempted flights of fancy, flights of oratory, and even flights of absurdity. Now he is about to go in for just plain flights. Daniel Guggenheim's endowment of $500,000 for an enlarged School of Aeronautics at New York University will prove one of the greatest steps forward yet made in this country in the art of flying. The plan of the new school calls for comprehensive instruction in aeronautical engineering, which will give us young men capable of the most skilled design and investigation in this new and fascinating field.

Mr. Guggenheim's generosity is matched by the University's excellent judgment in selecting Professor Alexander Klemin, a member of its faculty, and Aeronautic Editor of the Scientific American, to direct the school.

We congratulate the new school on its good fortune in securing so eminent an authority, and at the same time we must hand ourselves a bouquet in having our early judgment of Professor Klemin confirmed.

CANCER

JUST as we go to press, the newspapers announce that an English physician has found out what causes cancer. It is said to be a parasitic organism so small that it has heretofore evaded detection under powerful microscopes.

Doctors have long been divided into two camps on the question of what causes cancer. One camp—numerically the smaller—believes it is produced by a parasitic or outside organism, something like a germ. The other camp believes it is not caused by any parasitic organism.

The new discovery has been received with keen interest, tempered, however, with caution on the part of physicians, whose experience with discoveries of a similar nature in the past has made them wary.

We must not lose sight of the fact, moreover, that the discovery of the cause of cancer would not, in itself, provide a cure for it. The cure might soon follow, or it might not.

The Scientific American is strongly interested in the new discovery and will publish an account of it when—and if—it is accepted by science. Otherwise, to encourage sufferers falsely would be cruel.

MONEY

IT is a pleasure to announce that the $100 prize offered by the Scientific American in the essay competition on the motion picture "The Best Observed Eclipse in History" is awarded to Mr. John H. Chase, of Youngstown, Ohio.

Mr. Chase is to be congratulated on winning in a field where the competition was so close. Any one of a score of the essays submitted showed decided merit, worthy of a prize. Honorable mention, however, must go to Mrs. Alida Hammond, of Tucson, Arizona, Mr. Robert Clement, of Minneapolis, Minnesota, and Mr. Edward N. Fox, of Philadelphia, as runners up.

In This Issue

If Man's Ancestor Was Not a Monkey, What Was He?
We have yet to find the fossils of our ancestor, but the evidence of comparative anatomy indicates that he was, after all, similar to the modern monkeys and apes. Some, however, would side-step this unpleasant admission. On page 157, Albert G. Ingalls pleads for frankness on this question.

Slow Movies of Flying Bullets
Captain S. P. Meek of the Army Ordnance Department describes the apparatus at the Frankford Arsenal which snaps one-millionth of a second shadowgraphs of bullets in the air and shows the capers they cut. On page 158.

How High Can You Fly?
That depends upon your particular physical makeup. The government puts each of its birdmen through a set of interesting tests that reveal just how he will behave at any altitude and under any conditions. Read Boyden Spark's article on page 164.

Perhaps Our Universe Has Limits
Scientists have two reasons for thinking it may have; the fact that the night is dark instead of light and the fact that gravitation is not equal in all directions. Dr. Nicolas P. Rashevsky tells what kind of universe might account for these phenomena.

Bigger and Better Silkworms
It was fourteen hundred years ago that China taught the West the secret of the silk industry. Now Americans are teaching the Chinese how to produce a race of super-worms. The story on page 166 is an absorbing one.

MORE THAN 150 PICTURES

Complete table of contents will be found on page 216.

For Next Month

Voronoff's Own Story of Gland Grafting
The brilliant French surgeon in an exclusive interview describes for the readers of the October issue of the Scientific American his efforts towards making old men and women young again by gland transplantation. Not theory, not prophecy, but a record of what he has done and is doing.

Making the Mother Map of the United States
The topographic engineers of the Geographic Survey are visiting every square mile of the unsurveyed regions of the country, making the biggest map the world ever saw. They are charting the hills, the rivers and even the farmhouses as they climb snowy mountain peaks or break through trackless forests. Danger and adventure go into the making of the remarkable work described next month.

The Swift March Against Disease
Doctors have accomplished more in the last fifty years than in the preceding fifty centuries. Their solution of the mysteries of the human body and its ailments is one that should be related only by such a man as Morris Fishbein, M.D., editor of the noted Journal of the American Medical Association. He gives it in four parts—we publish the first next month.

Other articles on the subject of Mass Fingerprinting, on The Romance of the Fire Alarm, on Light Waves or Light Bullets?, as well as our invaluable listing of radio sets.

MORE THAN 150 PICTURES

¶ **Wonderful developments are taking place every day in the world of science. The Scientific American is watching and reporting these advances for you. You *cannot afford to miss a single issue.***

We will send the October, November and December issues to your home for one *dollar. You will want more.*

INVESTMENTS

MANY readers with money to invest have asked the Scientific American for advice about the soundness of certain types of securities. To provide them with worth-while information we have been fortunate in obtaining the services of Chase Donaldson, a recognized authority who makes the subject of finance interesting.

Each month Mr. Donaldson discusses some outstanding phase of the investment field in which you may be hoping to reap profit. He will not tell you the merits of this or that particular company, but will give you facts you need to have about the underlying principles that indicate success or failure in particular investment fields.

After all, investments in this country are all based on or affected by scientific developments. If you want to take as little risk as possible with your money, it will pay you to read what Mr. Donaldson has to say each month.

R. S. V. P.

MANY a brickbat and many a bouquet is tossed at the Editor and sometimes the readers and writers themselves hurl letters at one another through the Scientific American mail bag.

All this is mighty interesting—so interesting that we want you to enjoy it with us. Therefore, we have opened a new department, "In the Editor's Mail." It is yours. Make yourself at home.

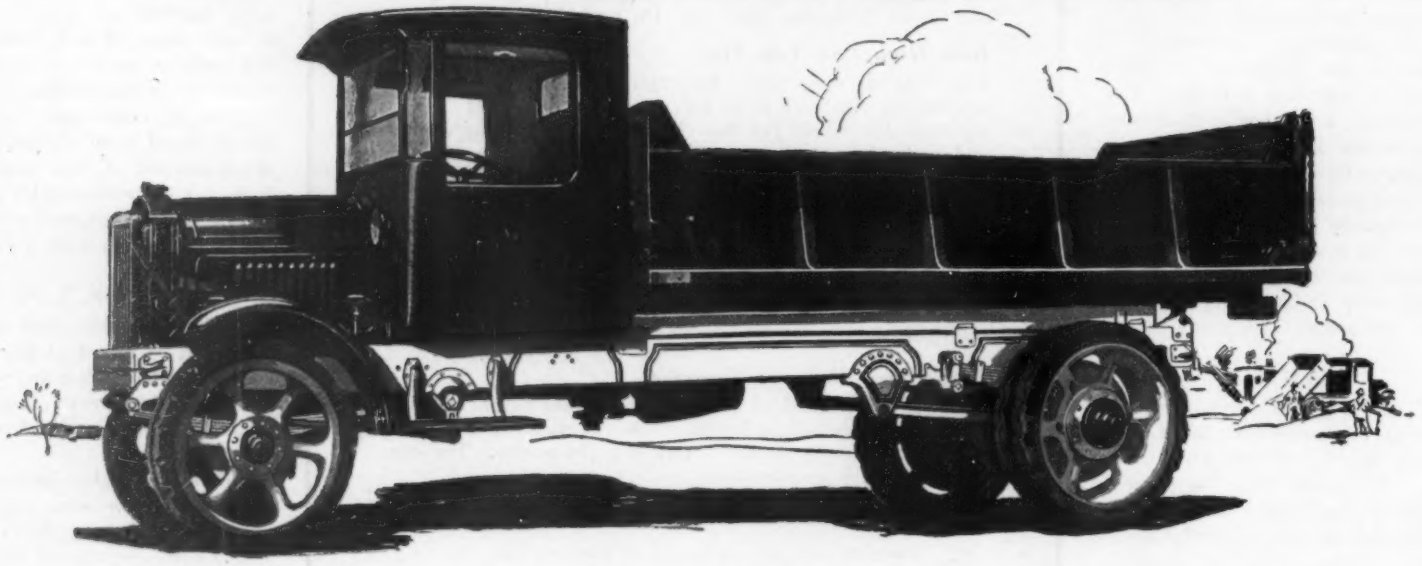
If you think we are on the wrong tack as we sail over some scientific course, if you see us making sins of omission or commission, if you want us to get your viewpoint, write us a letter. We shall try to find room to publish it. Or, if you have come across some interesting bit of information the rest of us ought to know, write and tell us about it.

HAPPINESS

DRIVEN by the exceeding warmth of last month, one of our editors fled for "coolth" (why is not that a perfectly good word?) to the Island of Newfoundland. It was 96 degrees in the shade in New York and 40 in Newfoundland, where icebergs were floating past the entrance to Saint John's harbor on their way south. The fishermen of that rugged island interested us. They are of good Scotch, English and Irish stock, rugged and clear-eyed, with red cheeks and revealing a charming native courtesy.

In the smoking room coming home conversation turned on the life of these people. An official of the Government told us that the average earnings of the fishermen is about $200 per year. This, with the help of the wonderful women of the country, who dig and plant and tend the small holdings of an acre or two, enables them to get along. "Are they happy?" asked one of the listeners. "Very happy," said the official with emphasis; and there came to our mind the saying from an old book, to the effect that "the happiness of a man consisted not in the abundance of his possessions. . ."

FEDERAL
MOTOR TRUCKS



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7-Ton	5000
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